The Electrical World.

VOL. XXX. NEW YORK, AUGUST 28, 1897. No. 9.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

253 Broadway, New York.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.

Western Office, 936 Monadnock Block, Chicago.

Philadelphia Office, 929 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,

In the United States, Canada or Mexico; other foreign countries, $6.00.

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THE ELECTRICAL WORLD,

253 Broadway, New York.

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THE NEW CONDUIT RAILWAYS.

The new conduit railways running the length of Manhattan Island from north to south, which are now being installed, are probably the finest examples of electric railway construction in the world. There are many points about them which happily illustrate the evolution in electric railway construction since the time when the horse-car lines began to be changed over into electric lines. With the coming of the new power there arose a demand for more rapid service, larger, heavier and smoother running cars, and consequently heavier and more substantial track construction. The evolution in track construction has been continuous from the 24-pound strap rail spiked down to wooden string pieces, of the early horse-car systems, to the magnificent construction now being placed in the streets of New York, and elsewhere illustrated in this issue.

It is probable that, for a time at least, this track construction will mark the limit of weight and solidity in street surface railroads. The girder rails used are heavier than those in the regular service of the highest class of steam railway, and even under the strain of the enormous surface traffic of our New York streets they will probably last for a long time. It is a notable fact that no attempt is being made in this work to use any of the more novel systems of rail jointing, such as cast-welded joints.

There is nothing in the construction of the new tracks which does not commend itself to the engineering sense as eminently appropriate and satisfactory. New York has waited a long time for better surface roads and better traction facilities, and it is a gratifying fact that it will soon have the best surface roads in the world, which will relieve the difficulties of the traction situation as far as surface roads ever can.

Another instructive feature about the new work is the survival in it of the oldest type of conduit. There have been an enormous number of conduit schemes; indeed, these have been a sort of *ignus fatuus* for inventors for the last ten years, and much time and money have been thrown away in the development of useless methods of conduction. Open slot conduits, closed slot conduits and sectional connector methods have all been tried, but it seems that the simplest and earliest form has been proven by trial in several places to be the best, and is that adopted in the present case. There is nothing more novel or striking about this conduit system of railways than its magnificent solidity.

ELEVATED RAILROADS ON THE BROOKLYN BRIDGE.

The contracts have at last been signed for the extension of the Brooklyn elevated and surface car systems across the bridge into New York City. The present plan provides in the case of the elevated trains that these shall abandon their steam engines at a station near the Brooklyn end of the bridge, shall be hauled up on to the bridge structure from that point by electric motor cars and thence drawn across the bridge by the cable system still in vogue upon that structure. It only needed compressed air somewhere to make this series of tractive methods complete.

There is one good thing to be hoped for, however, from this remarkable concatenation of traction systems, and that is that it will sooner or later compel the elevated railroads as well as the bridge to adopt electricity throughout as their motive power. As

the scheme is at present understood the cars must each be equipped with proper grips, and electric shuttle cars or locomotives will be necessary to bridge the gap between the end of the steam service at Tillary Street and the beginning of the cable service on the bridge. The bridge is already equipped with conducting rails along its whole length, and this will make a fair beginning with the electric system which will inevitably be installed over the whole of the Brooklyn elevated roads.

It is probable that on this side of the river we will have to wait for the example of the Brooklyn elevated companies or the interposition of Providence before we see electric traction on the present New York elevated systems. The equipment of the new conduit surface lines, however, will probably hasten the early adoption of electric motive power on the elevated structures in New York, a consummation which is devoutly to be desired.

THE RAPID TRANSIT PROBLEM IN NEW YORK.

A vast responsibility rests with the Supreme Court Commissioners, who are now holding daily sessions in this city to determine the practicability or impracticability of the plans for rapid transit in New York City prepared by the Rapid Transit Commission. The particular urgency just now in hastening definite action is because of the fact that contracts for the work of building the lines must be given out before January 1 next, when will take place the consolidation of the separate municipalities which will constitute the future Greater New York. In the event of the failure to accomplish this result before that time all the effort, time and money spent to give this city the much-needed and desired rapid transit will come to naught.

Should the court commissioners make an unfavorable report upon the plans rapid transit will be no nearer a realization than it was at the beginning of the agitation several years ago. When the subject is again taken up, as it surely must be, the entire work of the Rapid Transit Commission will of necessity have to be done over again under the new order of things, and it will require several years to secure any practical results. The failure, therefore, to render effective the work done by the Rapid Transit Commission would be deplorable, and a public calamity. It is to be hoped that the court commissioners, who are no doubt fully alive to the situation, will render a favorable report upon the practicability of the project, and thus avoid the public discontent that would certainly manifest itself in such a contingency.

The proposed plans are, perhaps, not the best that could be devised to meet the public needs, but their execution would certainly give very much needed relief to the great congestion of traffic. The existing lines both overhead and surface, are utterly inadequate to promptly move the vast bodies of people that travel up and down the length of Manhattan Island every day.

AN IMPORTANT TELEPHONE DECISION.

The recent decision by Judge Goff, perpetuating the injunction granted the Southern Bell Telephone Company against the city of Richmond, Va., has a very important bearing upon the conflict between the independent telephone interests and the Bell Company where these are in opposition. The decision in the injunction proceeding sustained the claim of the local Bell telephone exchange that its poles and wires formed part of the general interstate system for the communication of intelligence and was, therefore, not amenable to local or municipal regulations. The history of the case is in many respects peculiar. The franchise of the local Bell Company was granted in the early days of the telephone business, and was made terminable upon one year's notice from the City Council. This was given in December, 1894, and the franchise accordingly expired in December, 1895. At that time an independent local company was about to begin the construction of an exchange, and pending the completion of this the Council permitted the Bell Company to operate its lines. In due time notice was served by the city upon the management of the local exchange, requiring the removal of its poles and wires from the streets. An injunction restraining the city from interfering with the lines was promptly asked and granted, and has just been made permanent upon the grounds cited above.

The effect of this decision is to take away from the city its right of eminent domain in its own streets and to perpetuate to all intents and purposes the existence of a franchise originating in the municipal bodies and withdrawn in due form by them. It virtually supersedes the city's right of regulating the highways within its borders, and puts the telephone business upon a new basis. It is hard to say what the effect of it will be and whether it will or will not strengthen the position of the Bell Company in its struggle with independent opposition.

A singular feature of this case is that the exchange at Richmond is isolated, having no long-distance connections with points outside of the State. It is likely that this decision will furnish an important precedent, and it is to be hoped it will soon come up for revision by a higher court, so that the precise status of telephone companies in this regard may thus become definitely known.

Important Amendments to the Patent Statutes.

Public document No. 133, entitled "An Act Revising and Amending the Statutes Relating to Patents," has just been printed. The amendments are several in number, the most important being the following: Section 4886 is amended to read that an invention which has been described in a printed publication in the United States more than two years prior to the date of application for a patent therefore shall become public property. This provision makes it imperative that inventors should make haste after their inventions are perfected to file their applications. The second important amendment is to Section 4887. This provides that foreign patents upon American inventions may be taken out immediately after the filing of the application for the invention in the United States, without causing any limitation of or injury to the American patent when issued, and also that a foreign inventor, if he desires to procure a patent upon his invention in the United States, must file his application here within seven months from the date of his application in a foreign country.

Arrangement of Pit Lamps.

A usual and quite good arrangement of lamps in the changing pits of a barn or shop is to allow five lamps to each pit, arranging them alternately on opposite sides of the pit, and the lamps in each pit controlled by a separate switch. There is an improvement possible in this arrangement, and that is to run another circuit, independent from the one above noted, and place a lamp at the end of each pit, just where the floor stops. All of these lamps are to be controlled from a switch, independent of the other lights. If there are five pits there will be ten lamps that are burning all the time.

This arrangement will prevent many a fall in dark weather, and it will enable the men to find tools that may be in the pits without having to turn on all the regular pit lamps in all of the pits in order to find what is wanted. The lamps in the above circuit, or double circuit, to burn all the time; the regular pit lamps only during actual time of work in each pit. The extra light is very welcome in pits that are very long, and where one of the lamps has to be made portable by putting it on the end of a long flexible cord.

Metal Work in Place Ready for Concrete.

The Underground Trolley in New York City.

New York City has become conspicuous during the last few years for its adherence to that relic of the last decade, the horse car. While every other city and town in the country has made haste to substitute electric traction, almost all of the surface lines of New York are still operated by horse power. The reason for this is not conservatism or a lack of appreciation of electrical methods, but a strong objection on the part of Father Knickerbocker to overhead wires in the streets. The patience of New York's citizens is at last to be rewarded by the installation of the finest electric railroad in the world.

About three years ago the Metropolitan Street Railway Company, operating some 150 miles of surface trackage by horse and cable, started the construction of an experimental open-slot conduit line with which to determine the relative merits of electric conduits and cable roads. The original line on Lenox Avenue was extended across 116th Street and on to upper Lexington Avenue, about 4 miles of double track being now in operation. These tracks were provided with conduits deep enough to hold cable sheaves in case the electric system was unsatisfactory. Two Hoadley compressed-air motor cars have also been running on the lines of the company for the past year.

These test lines having proven the superiority of the conduit electric road for the conditions in New York City, the company is now at work equipping four more of its lines with the same system. These are the Madison Avenue line, which runs from the Post Office via Centre Street, the Bowery, Fourth and Madison Avenues, to the Harlem River; the Amsterdam Avenue line north from Fifty-ninth Street; and the Fifty-ninth Street and Twenty-third Street cross-town lines. The aggregate length of these lines is 45 miles, single track measurement. The Second Avenue line will also be equipped this year, and the Sixth and Eighth Avenue lines as soon as legal obstructions can be removed.

Between 2000 and 3000 men are now at work laying the new tracks alone. The tracks are of the most massive construction. Scale cross-sections of the various rails are shown herewith. The weights of these per yard are as follows:

Tram rails	107 pounds.
Slot rails	58 pounds.
Conductor	21 pounds.
Conduit plate	16 pounds.
Total	200 × 2, or 400 pounds

of steel per yard of single track. The cast-iron yokes are spaced 5 feet between centres. Every third yoke is a hand-hole yoke and weighs 600 pounds. The intermediate standard yokes weigh 410 pounds each, making a total weight per yard of 500 pounds of metal.

The rails are fastened together by heavy twelve-hole fish plates. The bolts are 1⅛ inches in diameter, there being two rows of them, one over the other, six bolts in a row. The conduit is not as deep as the cable conduits, and does not, therefore, necessitate the removal of underground piping. The total depth of excavation is only about 30 inches. The conduit shell is made of concrete, 4 inches in thickness, carefully made with Portland cement. On each of the yokes

is cast a set of lugs which serve to hold in place wooden boards forming a temporary retaining wall for the outside of the tube of concrete forming the conduit. The oval interior surface is formed by sheets of steel plate bent to fit the yokes and sustained in place by sectional wooden shapes, which are removed after the work is completed. The concrete, made of fine broken stone and Portland cement-mortar, is rammed in between the steel lining of the yokes and the outer boards, which are subsequently removed. A 6-inch bed of concrete is also laid for a pavement foundation.

Current is supplied to the system by two T-shaped conductor rails, one serving as a supply and the other as a return conductor. The system therefore is not grounded. The rails are supported, as shown, by porcelain insulators every 15 feet in the hand-holes. These insulators are cemented in a cast-iron shell, which is bolted to the lower flange of the slot rail. A pin cemented into the insulator carries the conducting rail.

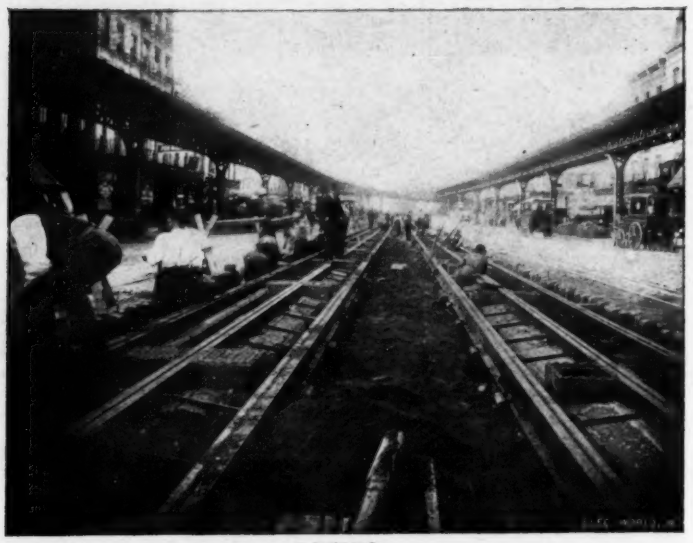
The problem of bonding is much simplified by the use of a return rail in the conduit. The conducting rails are not jarred by the pounding of wheels, and are not buried in material soaked with corrosive liquids. The bond to be used is provided with a cast-copper stud, which is turned down to fit in a hole in the web of the rail. The stud is then expanded by a taper pin passed through it and pulled up by a nut.

Current will be supplied for the lower part of the island from the Twenty-fifth Street power station. This station at present drives the Lexington Avenue cable line, but it will be increased by the addition of four 800-kw General Electric generators, direct connected to horizontal Corliss engines made by the Pennsylvania Iron Works. Three similar units will be added to the present equipment at 146th Street, for driving the upper part of the system. Ground has been bought for a large station at Ninety-sixth Street and the East River, which will eventually supply current to the whole system on the multiphase distribution system.

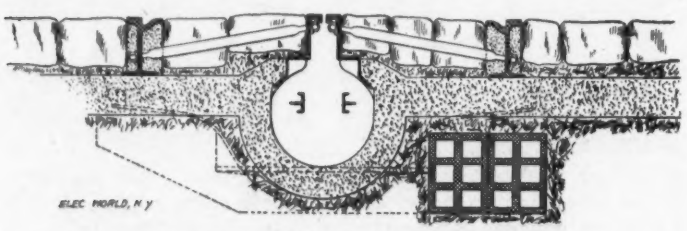
Building the Concrete Walls of the Conduit.

The Yokes in Place, Ready for the Rails.

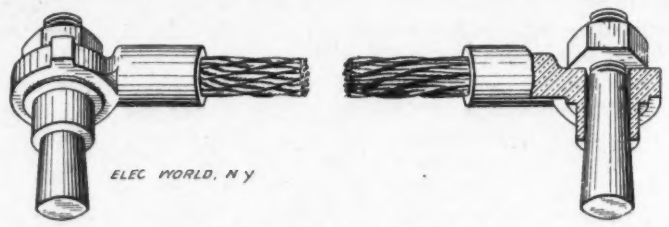
The Excavation, Full Depth. The Yokes Are Inverted.



Concrete Conduit Complete, Showing Hand-Holes.

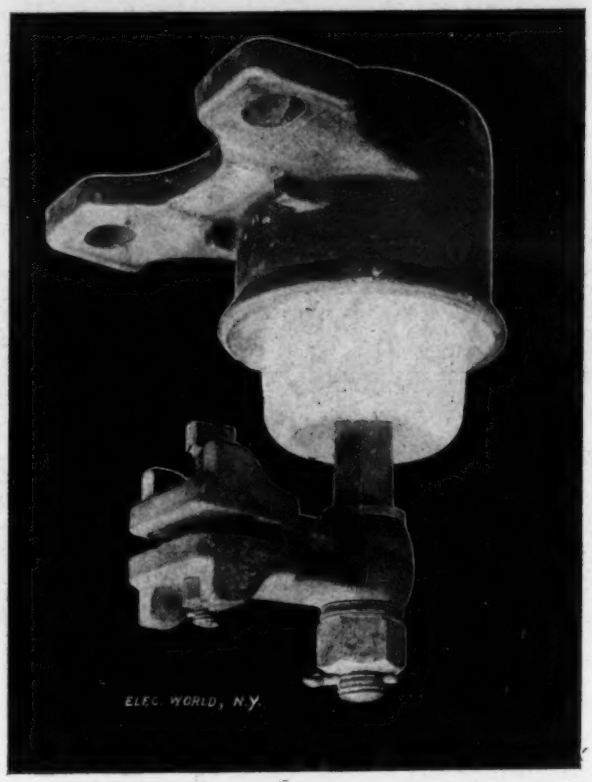


Cross Section of Track and Conduit.



Conductor Rail Bond.

None of the special track work incident on crossing other tracks and so forth has as yet been started. The Amsterdam Avenue line will run on Columbus Avenue for about 1500 feet, where cable cars are now running. The tracks will be gauntleted with just space



PORCELAIN INSULATOR WITH SHELL AND PIN.

enough between centres to allow the two conduits to be independent. This will necessitate replacing all the yokes of the cable line, and the intention is to keep the cable line in operation while the work is being done. No definite figures of the cost of this construction have yet been made public, but it is safe to say that they exceed those

ROW OF 600-POUND HAND-HOLE YOKES INVERTED.

for any other electric surface road in the world. The track is probably the heaviest ever laid for a street railway of any kind.

The illustrations show several stages of the construction on the Bowery, where the work is rendered particularly difficult by the close proximity of the cable tracks of the Third Avenue road on either side.

Through Cars on the Brooklyn Bridge.

On Monday, August 23, the contracts were signed for the extension of the lines of the Brooklyn elevated and surface car systems across the New York & Brooklyn Bridge.

The plans provide for the carrying of the elevated cars on the tracks now used by the bridge cars. New tracks will be laid for the trolley cars in the present roadways of the bridge, one track in each roadway, close to the outside truss of the bridge. In this there is no change from the plan illustrated in THE ELECTRICAL WORLD of February 13, 1897. The trolley cars will be run by electric power, as on the streets, but the elevated cars will be fitted with grips and hauled over the bridge by cable traction. The steam engines of the elevated lines will abandon the trains at the Tillary Street station, electric motor bridge cars hauling them from there to the bridge proper, and cables from that point on.

The design of adequate terminals at the New York end has been a very difficult problem, and many plans have been developed and rejected. The final project provides terminals for the trolley cars over those now used for the bridge trains. Some distance back of the New York terminal the tracks will swing out over the coping stone at the sides of the bridge, and then rise until 15 feet above the roadway, when they will swing in over the latter, and run double track just outside the walls of the present train shed. A section of the train-shed roof 150 feet long at the Park Row end will be raised 16 feet, and under this raised section four loops will be run, connecting west-bound tracks on the one side with east-bound tracks on the other. These loops will run between loading and unloading platforms, which will be 46 feet above the street level. Twelve elevators will be provided to carry passengers up and down. Nine of these will run to the street level, and three to the gallery which now runs to the Manhattan Elevated railroad station and City Hall Park. The elevators will have a capacity of 12,500 passengers per hour.

A new island platform will be built between the two tail tracks now used for switching bridge cars. This platform will be used for a terminal for the elevated railway trains.

The speed maintained on the bridge by the trolley cars will be about 7 miles per hour, and the minimum headway specified is 12 1-3 seconds. The trolley lines are to pay for the bridge privileges 5 cents per car per round trip, and the elevated lines 12½ cents per car per round trip.

Consolidation of the Siemens & Halske Electric Company and the Pennsylvania Iron Works Company.

Formal consolidation of the Siemens & Halske Electric Company of Chicago and the Pennsylvania Iron Works Company of Philadelphia has been effected. It has just been announced that all but about 300 shares of the capital of the Siemens-Halske corporation has been exchanged for stock of the Pennsylvania Company, so that the latter is now in the control of the Chicago corporation. The offer of the Pennsylvania company to take over the stock of the Chicago concern became operative June 17, and the shareholders of the Siemens-Halske company were given sixty days, or until August 17, to accept the proposition. It is said that every shareholder in this country has made the exchange. Friends of those absent have assured the chairman of the committee having the matter in charge that their stock would in due course be also exchanged.

The general manager of the Pennsylvania company, B. W. Grist, is now in Chicago, and is managing the Chicago works. The Pennsylvania company's letter heads announce that it is operating the Siemens-Halske electric works of Chicago.

The capital of the consolidated concern would, it was announced a short time ago, be $5,000,000, and that it would be listed on the leading stock exchanges of the country. The issued capital of the two corporations stand as follows:

	Penn. Co.	S. & H. Co.	Total.
Preferred	*$1,750,000	$ 700,000	$2,450,000
Common	1,500,000	1,275,000	2,775,000
Total	$3,250,000	$1,975,000	$5,225,000

*Six per cent. noncumulative.

Electric Cabs in London.

The electric cabs that were introduced a few days ago on the streets of London are in great demand. Only two of them are plying for hire, the others having been pre-engaged for 25 shillings a day.

The company owning the vehicles say that they could let hundreds of them if they possessed them. They hope to add three new ones weekly.

Conduit Construction in St. Louis—II.

BY FRANK CLARK COSBY.

In taking up the description of that part of the underground work in St. Louis in which the wrought-iron cement-lined pipe of the National Conduit and Cable Company, of New York, is used, it seems pertinent to go back a few years in order to describe briefly the only conduit system in service in St. Louis up to the time of the passage of the ordinance requiring all wires and cables, except those used for railway purposes, to be placed underground.

In September of 1889 there was completed the major part of a conduit system in which about 100,000 duct feet of wrought-iron cement-lined pipe was used to connect fifty manholes, the work being done for the St. Louis Underground Service Company. This involved opening about 6000 feet of trench, as the ducts were laid in three horizontal layers of six ducts each, or eighteen ducts in all. Subsequently the system was added to, so that now it aggregates more than 1 1-5 miles. In this conduit there has been placed and is working a thirty-wire telegraph cable laid by the Standard Underground Cable Company for the Postal Telegraph Cable Company, the only underground cable in the city, which in May

Trench Work, Showing Layers of Cement Lined Pipe Upon Concrete Bed and Encasement.

1896, when the terrible cyclone visited St. Louis, proved of incalculable service to the company owning it, as it was in no wise affected by the storm, but was successfully operated while all the other downtown wires were out of use.

The cost of this installation was infinitely more expensive than similar work nowadays, due almost wholly to the fact that the company was required to place a bed of Portland cement concrete 9 inches thick in the bottom of its trench, upon which the pipe was laid. The manholes were very solidly built of brick and were usually 5 × 5 feet, although some 8 × 8 feet were put in, and all were fitted with double cast-iron covers. The complete cost amounted to very nearly $100,000.

The first company to actually undertake the work of placing conduits underground in accordance with the requirements of the general ordinance was the Cupples Station Light, Heat & Power Company, an isolated plant furnishing light and power to the large warehouse buildings owned by the Cupples Real Estate Company. In view of the small area involved and the comparative isolation, the necessary permits from the Board of Public Improvements were readily obtained, and the work finished before the larger companies were ready to begin. The conduits were run from the central station in one building to each of the buildings required to be supplied with light or power, and as the service throughout contemplates the use of a direct current, no transformer pits were required. The general plan of laying and jointing of ducts, construction of manholes, etc., was similar to that to be subsequently described under another head in this article, and so will be omitted here.

In this installation 26,000 feet of cement-lined pipe were used, occupying about 1 mile of trench. The conduit was placed wherever possible in unpaved alleys and the cost of installation thereby greatly reduced, as there was no repaving to be paid for in these cases, an important item.

Mr. E. C. Parker, the engineer under whose direction the work was done, laid out his system and built his manholes according to

Trench Ready for Concreting, Showing Cement-Lined Iron Pipe Jointed Together.

the following plan: The system being small (there were only sixteen manholes in all), he decided to build manholes with solid covers and ventilate them by means of air forced in under pressure at his lowest manhole, to go through all manholes in series and out of his highest manhole, which he provided with a ventilated cover for this purpose—all the other manholes having solid covers. To do this the trench had to be properly graded throughout and continuously, and this fact was made use of for draining the system, where the reverse plan was adopted, namely, a sewer trap and connection was placed in the lowest manhole alone, and the whole system made to drain into it by means of the natural grade of the ducts. By this means the last manhole was kept absolutely free of water and the other manholes free above the level of the

Cement-Lined Iron Pipe Entering Manholes.

lowest ducts, between them and the bottom of the vault being the maximum depth to which water could collect in any manhole, and this being taken care of by pumping out each hole whenever necessary. These manholes were built of a uniform size, 4 × 4 feet, with head room varying according to the depth, which depended upon the grade.

This work was very satisfactorily and cheaply done by the Abbott & Gamble Contracting Company, of St. Louis, at a cost of less than $4000 complete, an extremely low figure; and is now ready to receive the cables for which it is intended.

Undoubtedly the greatest amount of work in the construction of a conduit system in St. Louis is that being undertaken by a local corporation formed for the specific purpose of doing this work, and under the direct supervision of Mr. H. A. Wagner, general superintendent of the Edison Illuminating Company and the Missouri Electric Light & Power Company. This corporation is composed of a company who manufacture the pipe and the Abbott &

HAND HOLE AND COVER.

Gamble Contracting Company, of St. Louis, who are personally in charge of its installation. This work is at present the only "high-tension" conduit under construction, and is for the joint use of the following light and power companies: Edison Illuminating Company, Missouri Light & Power Company, St. Louis Electric Light & Power Company, Phoenix Light, Heat & Power Company, and the Edison Electric Illuminating Company, of Carondelet. When completed it is estimated it will comprise 1,400,000 feet of pipe, about 30 miles of trench, 300 manholes and 1000 handholes, and will cost between $350,000 and $400,000.

This system is laid out with a view to using as far as possible an alternating current only, although a 500-volt direct-current will be available for power purposes where absolutely necessary. It is the intention of the engineers to connect all their power houses electrically, so that in case of a mishap or shut-down on any one, service can be given from one of the others without any inconvenience to their customers. The primary circuits will all be single-phase, 1100 volts, for incandescent and arc lighting and power, and the secondaries, three-wire 220-volt circuits. The transformers (water proof) will be placed in the larger-sized manholes in pits arranged especially to receive them, as will also the junction boxes for distribution from the secondaries. These secondaries will be either three-wire Edison tubing or a regular three-wire cable and run into the handholes, from whence service connections are conveniently made through iron pipe laterals issuing from the handholes to the place desired to be supplied with energy. By this means the old practice of placing small transformers upon the outside of buildings is completely done away with, and all connections to buildings are entirely underground.

Cement-lined wrought-iron pipe, the kind of duct selected for this work, has the characteristic of being easy to lay and joint, and can be rapidly installed, as it is made in 8-foot lengths, is very light in weight, which enables it to be handled with ease, and requires no particular skill in jointing. In a trench in St. Louis in which twenty ducts were to be put in, 12,820 feet of pipe were laid in one day, requiring the services of an ordinary gang of men—thirty-six concreters, fifty-two laborers, six bricklayers, and six helpers, with six overseers. The trench in this case was open and the work included the building of one and one-half manholes and four handholes as well. But on the preceding day, with a gang of 108 laborers, forty concreters, five bricklayers, and five helpers, with seven overseers, a ditch 1177 feet long was opened, five ducts put in and the whole filled in and finished before quitting time that night, including work upon the manholes and handholes intervening. These

IRON PIPE LAID NEAR STREET SURFACE.

"runs" are to be considered more in the light of "record runs" than common practice, perhaps, but show what can be done under favorable conditions—an average of 5000 duct feet a day, complete, being the usual run.

The pipe itself consists of a wrought-iron shell of No. 26 B. W. gauge, tarred upon the outside to prevent rusting, riveted every 2 inches for security, and lined inside with a layer of pure Rosendale cement five-eighths of an inch thick. The internal diameter is 3 inches, making the external diameter approximately 4½ inches, and by some special process the interior surface of the cement is highly polished, thus removing all roughness, which would be a source of considerable trouble when it becomes necessary to draw in cable.

This pipe is made in lengths of 8 feet, which weigh between 40 and 48 pounds, and is fitted with an iron casting on each end for a male and female joint. After the pipe is made at the factory it is allowed to harden from ten days to two weeks before being sent out for use.

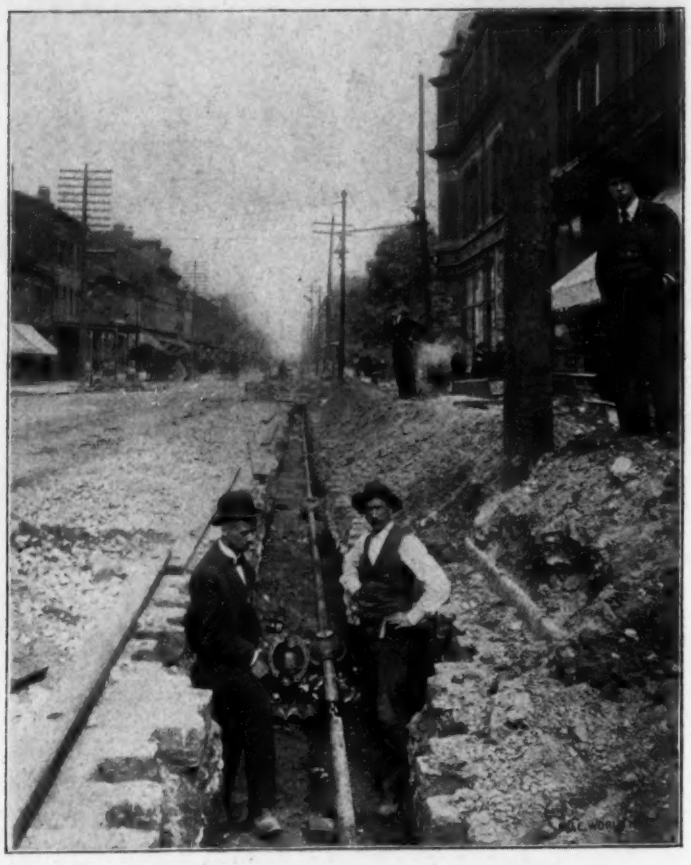
In laying this pipe, the general plan adopted for all such work has been followed: grading the trench so as to drain properly, putting in a bed of concrete 3 inches thick, then the pipe, surrounding it on the sides with 3 inches of concrete and covering it on top with a layer also 3 inches thick. This concrete is made of 1 part American Portland cement, 2½ parts sand and 5 parts crushed stone; the pipe is laid 5½ inches between centres, with a 1-inch bed of concrete between layers. The joints in adjacent ducts and layers are not broken and so occur in the same vertical plane, the individual joints being surrounded by a mold or casing of cement mortar, mixed 1 part cement to 2 of sand.

The usual depth at which the pipe is placed is 5 feet below the surface for the bottom layers, though, of course, this depth is dependent upon the number of ducts to be used, as care must be exercised not to get the top layer too near the surface. On top of this pipe is placed the "three-wire Edison tubing," which is used to a certain extent by the light and power companies doing the work for local distribution, and is therefore placed as near the surface as possible, leading into shallow handholes which are located wherever most convenient for connection to buildings, usually averaging 80 feet apart.

This tubing consists of sections of iron pipe 20 feet 6 inches long, and of a diameter dependent upon the size of the conductors enclosed—2½ inches in diameter for a pipe containing three conductors of 250,000 c. m. each, the size most generally used, though these conductors range from 200,000 c. m. to 500,000 c. m. This tubing is made by taking three conductors of the desired size and insulating them from each other, usually by means of a wrapping

of jute or cotton string, pulling them into the tube with the ends projecting for connecting and sealing the ends with some special compound. The short sections are then joined together by a stranded flexible coupling, soldered to insure good contact, and then surrounded by a cast-iron coupling box of two parts, bolted together and afterward filled with hot compound, to seal it and keep out moisture.

The handholes are made 3 × 3 feet and 3 × 4 feet, and are 2 feet deep, and support an iron frame weighing about 800 pounds, which



Edison Tubing and Coupling Box. Cement-Lined Pipe Beneath.

carries a small solid cover, weighing perhaps 250 pounds. The walls are 9 inches thick and are made of hard-burned sewer brick. The bottoms are concreted to a depth of 3 inches, and in many instances the top layer of the cement-lined pipe opens into the handholes beside the Edison tubing, which affords a twofold system of distribution.

The regular manholes are placed at the intersections of streets and range in size from 8 × 8 feet, the larger, to 5 × 5 feet, the smaller, both having 6 feet 6 inches head room in the clear. They are built with 13-inch walls of hard-burned sewer brick, have a concrete bottom 8 inches thick, with a sewer connection where practicable, consisting of a trap and valve. Where it is impracticable to put in a sewer connection, a pipe 18 inches in diameter is sunk in the bottom and the bottom graded down to drain into this pipe, from which the water can be easily pumped out when necessary; this pipe or sump is usually covered with a grating to keep out dirt and refuse matter. The roof is made of 5-inch I-beams and brick arches, and supports a heavy iron frame weighing between 800 and 900 pounds; this frame carries a rectangular cover weighing 200 pounds, grated for purposes of ventilation, of dimensions 30 × 30 inches.

The Pacific Cable.

Information has been received recently at the State Department at Washington regarding the projected cable between British Columbia and Australia, which leads the officials there to doubt the statements in a recent dispatch from Victoria that the British Government has already arranged to lay a cable by way of Hawaii. The department has not been informed that the Hawaiian Government has given permission to any British company or to the British Government to land a cable line on the island.

Alternating Current Machinery.—XV.

By Edwin J. Houston and A. E. Kennelly.

Impedances in Parallel.

130. The effect of connecting condensers in parallel in alternating-current circuits calls for no special consideration. Their reactances, with or without associated resistance, enable their individual impedances to be determined, then their individual admittances, then their total admittance as the vector sum, and finally their joint impedance. Condensers associated in parallel with inductance coils call, however, for special consideration, and have some practical importance.

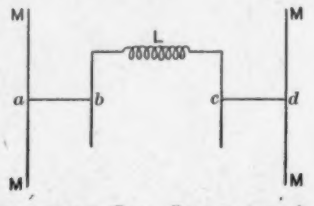


Fig. 81.—Inductance Coil Connected Across Mains.

In Fig. 81, let L be a coil having a resistance of 10 ohms and an inductance of 0.3 henry, connected by the branches $a\,b$ and $c\,d$, to a pair of alternating-current mains, $M\,M$, $M\,M$, between which is maintained a uniform sinusoidal E. M. F. of 1000 volts effective, with a frequency of 125 ~ or angular velocity $\omega = 785.4$ (¶ 24). The reactance, X, of this coil will be $j\,L\,\omega = j\,0.3 \times 785.4 = j\,235.6$ ohms, so that the impedance of the coil will be $10 + j\,235.6 = \sqrt{10^2 + 235.6^2} = 235.7\ \angle\tan^{-1}\frac{235.6}{10} = 235.7\ \angle\tan^{-1}\ 23.56 = 235.7\ \angle 87^\circ\ 34'$ The current strength which will flow through the circuit $a\,b\,L\,c\,d$, Fig. 1, will be $\frac{1000}{235.7\ \angle 87^\circ\ 34'} = 4.241\ \angle 87^\circ 34'$ amperes.

This is represented in Fig. 82, where *OABCDEFGH* shows the sinusoidal E. M. F. of 1414 volts amplitude (1000 volts effective) (¶ 52) to the right-hand scale, and *oabcdefgh* the corresponding current circuit of 6 amperes amplitude (4.243 amperes effective) to the left-hand scale, lagging 87° 34′ behind the E. M. F., the distance $H\,j$ being nearly 90° and j being later in time than H.

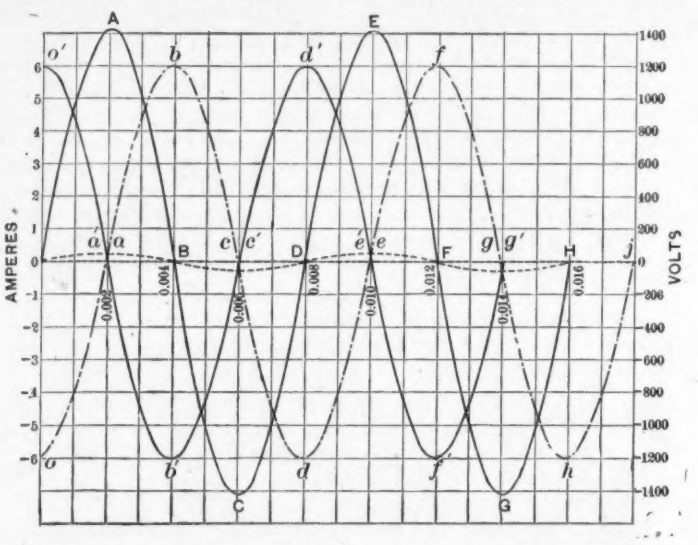


Fig. 82.—Diagram of Currents Supplied to Inductance Coil and Condenser in Parallel.

Next, suppose that, as in Fig. 83, a condenser of 5.4 microfarads capacity (5.4×10^{-6} farad) is connected across the same mains through the wires $a\,b$ and $c\,d$. The reactance of this condenser will be (¶ 116) $\frac{-j}{5.4 \times 10^{-6} \times 785.4} = 235.8\ \angle 90^\circ$ ohms and the current strength supplied through the condenser will be $\frac{1000}{235.8\ \angle 90^\circ} = 4.241\ \angle 90^\circ$ amperes. This is represented in Fig. 82 by the line $o'a'b'c'd'e'f'g'$, which is a sinusoid of approximately 6 amperes amplitude, or 4.241 amperes effective, advanced 90° or 0.002 second ahead of the impressed E. M. F., $g'H$ being 0.002 second and g' being earlier in time than H. This current will be supplied through the branches $a\,b$ and $c\,d$.

If now the reactance coil L and the condenser C be connected in parallel, as shown in Fig. 84, then, assuming that there is no sensible drop of pressure in the branches $a\,b$ and $c\,d$, each of these devices will receive its current independently of the other, so that at any instant the current flowing through $a\,b$ and $c\,d$ will be the sum of the instantaneous currents in L and C. But these currents are nearly in opposition. If they were completely in opposition and had equal amplitude, their sum at all instants of time would be

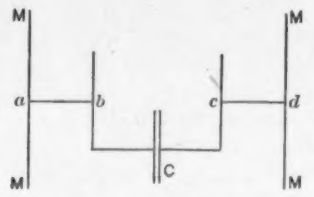


FIG. 80.—CAPACITY CONNECTED ACROSS MAINS.

zero, and no current would flow through the branches $a\,b$ and $c\,d$. But since the current in L is retarded only 87° 34′ while the current in C is advanced 90°, there is a small current which is the sum of the ordinates on the oab and $o'a'b'$ lines, and which is represented by the dotted line $OBDFA$ in Fig. 82. This curve is a sinusoid of approximately 0.25 ampere amplitude, or about 0.18 ampere effective, and it is in step with the impressed E. M. F. Consequently, we have in Fig. 84 a current of about 4½ amperes

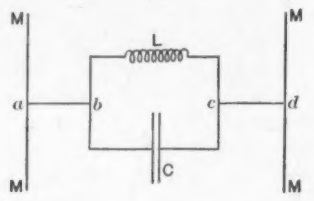


FIG. 84. — INDUCTANCE AND CAPACITY CONNECTED IN PARALLEL ACROSS MAINS.

flowing through the condenser, a current of about 4¼ amperes flowing through the inductance coil, and a current of only about one-fifth of an ampere supplied to both jointly from the mains. The current in L is nearly in retarded quadrature with the main pressure. The current in the condenser is in advanced quadrature with the main pressure and the currents in $a\,b$ and $c\,d$ are in phase with the main pressure.

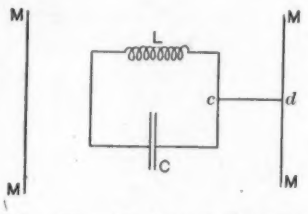


FIG. 85.—RESONANT CIRCUIT.

131. The impedance diagram of the preceding case is shown in Fig. 86. Here $o\,r = 10$ ohms, and $r\,l = 235.6$ ohms, so that $o\,l = o\,r + r\,l = 235.8\,\underline{/87°\ 32'}$, the impedance of the coil. The dotted line $o\,y$ represents the reciprocal of impedance, or the admittance of the coil, to a different and more convenient scale $= 4.24 \times 10^{-3}\,\underline{/87°\ 34'}$ mho. $o\,x$ represents the reactance or impedance of the condenser $= j\,235.8$ ohms, while $o\,y'$ represents the admittance of $\frac{1}{-j\,235.8} = j\,4.24 \times 10^{-3}$ mho. The joint admittance will, therefore, be $o\,y' + o\,y = O\,Y = 0.18 \times 10^{-3}$ mho and the joint impedance will therefore be $\frac{1}{0.18 \times 10^{-3}} = 5562$ ohms. The combination of inductance and capacity therefore acts as a resistance of 5562 ohms, a resistance too large to be conveniently represented on the diagram to the same scale.

132. The simplest way of effecting the preceding summation is, perhaps, by the retention of complex quantities in the admittance. If an impedance be expressed as $Z = R + jX$ ohms, the corresponding admittance $\frac{1}{Z} = Y$ may be expressed as $G + j\,B$ mhos, where G is the conductance and B the susceptance. The values of G may be found directly from the formula $G = \frac{R}{R^2 + X^2}$, while the value of B may be found from the formula $B = \frac{-X}{R^2 + X^2}$.

Thus, in Fig. 86, $Z = 10 + j\,235.8$ ohms,

$$G = \frac{10}{10^2 + 235.6^2} = 0.18 \times 10^{-3}\ \text{mho},$$

$$B = \frac{-235.6}{10^2 + 235.6^2} = -4.24 \times 10^{-3}\ \text{mho}.$$

Consequently, $Y = G + j\,B = 0.18 \times 10^{-3} - j\,4.24 \times 10^{-3}$ mho.

Again, Y' the condenser admittance is $= +j\,4.24 \times 10^{-3}$ mho. Consequently, the total admittance is 0.18×10^{-3} mho. It will be observed that in this case the condensance is very nearly equal to the reactance, or $\frac{1}{c\,\omega} = l\,\omega$. If there were no resistance in the circuit this is the condition which determines the least joint admittance, the greatest impedance and the least joint current from the mains. In fact, if a perfect condenser having no resistance were connected

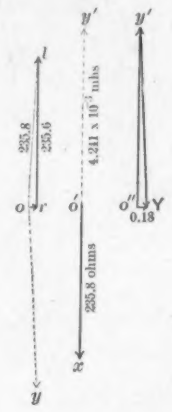


FIG. 86.—IMPEDANCE DIAGRAM OF CASE REPRESENTED IN FIG. 84.

in parallel with a reactance coil having no resistance, and the two were adjusted that their reactances were equal and opposite, it is easy to see that their joint admittance would be zero, and their joint impedance would be infinite. Thus, in the case of Fig. 84, if the coil could have a resistance of zero ohms, instead of 10 ohms, and a corresponding slight modification were made in the capacity of the condenser, the total current supplied from the mains after the first initial charge would be zero, and the branch ab might be disconnected as represented in Fig. 85, without in any way altering the system. In this purely ideal case, the condenser C and the inductance L, having equal and opposite reactances without resistance, would complete a purely resonant system (¶ 120) and the two would continue to oscillate forever at the frequency of 125 ~, delivering about 4¼ amperes in the circuit. Considered from this point of view, the current in the branch C would always be in phase with the current in the branch L of the closed resonant CcL.

In practice there must always be appreciable apparent resistance, not only in the coil L, but also in the condenser C, so that the resulting admittance can never be zero, and a resulting current must always flow from the mains, and the greater the resistance in these devices the greater will be the resulting current.

133. Thus, suppose that an incandescent lamp of 50 ohms resistance hot, is inserted in circuit with the inductance branch L, and a similar lamp in circuit with the capacity branch C, the capacity being also reduced to 5.3 micro-farads. The impedance diagram of this case is shown in Fig .87. The impedance of the condenser is $50 - \frac{j}{5.3 \times 10^{-6} \times 785.4} = 50 - j\,240.2$ ohms $= o\,r + o\,x$. The admittance of the coil is, therefore, $o\,y$ to a suitable scale $= 0.83 \times 10^{-3} + j\,3.99 \times 10^{-3}$ mhos. The impedance of the coil is $(50 + 10) + j\,235.6 = 60 + j\,235.6 = o'\,r' + r'\,x' = 243.1\,\underline{/75°\ 43'}$. The admittance of the coil is, therefore, $o'\,y'$ to a suitable scale $= 1.015 \times 10^{-3} - j\,3.99 \times 10^{-3}$ mhos. The total admittance is, therefore, $o\,y + y\,y' = O\,Y = 1.845 \times 10^{-3}$ mho. The joint impedance is the reciprocal of this or 541.9 ohms, as represented by OZ, so that the condenser and coil with the additional resistances inserted behave jointly like a resistance of 541.9 ohms.

The capacity c, which will cause the minimum current to be supplied from the mains to a reactance of resistance, r, and reactance, x, when connected in parallel is expressed by the formula $c = \frac{l}{r^2 + x^2}$ farads; or, $\frac{l}{z^2}$ where z is the impedance of the coil. Thus, the capacity which should be connected in parallel to a choking coil having an impedance of 200 ohms and an inductance of 0.2 henry is $c = \frac{0.2}{40{,}000} = 5$ microfarads. Again, in the case considered in connection with Fig. 84, $l = 0.3$ and $z = 235.8$, so that $c = \frac{0.3}{(235.8)^2} = \frac{0.3}{55{,}602} = 5.394 \times 10^{-6}$ farads $= 5.394$ microfarads. If then, the resistance r is negligibly small by comparison with the reactance x, this formula becomes $c = \frac{l}{x^2} = \frac{l}{l^2\,\omega^2} = \frac{1}{l\,\omega^2}$ farads, so that the capacity reactance is equal and opposite to the inductance reactance, as we have already pointed out.

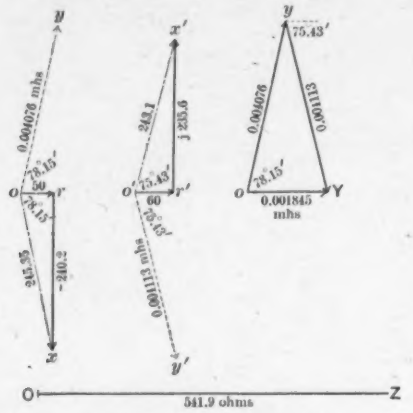


Fig. 87.—Impedance Diagram.

134. If the shunting condenser C, Fig. 84, has resistance in its own branch, then there are two capacities in the condenser which make the current from the mains a minimum, but for practical purposes it is usually sufficient to make the condensance equal to the coil's reactance.

135. If, then, a reactance coil be connected in series with a condenser of equal and opposite reactance, the two form a resonant branch, and the current which will be supplied to them from a pair of mains will be in excess of that which would be delivered to either. If, however, the coil and condenser be connected in parallel, the current supplied to them jointly from the mains will be in defect of that which would be supplied to either separately.

Some Tests on the Variation of the Constants of Electricity Supply Meters, with Temperature and with Current.*

BY G. W. DONALD RICKS.

The general object of the tests to be described in this paper was to afford a means of studying the behavior of direct-current electricity supply meters with regard to variations in the accuracy of their indications under varying conditions of temperature, current and potential difference.

Some of the more important meters were put through a series of tests which aimed at ascertaining—

1. How the accuracy of the meter depended upon the current at various constant temperatures, all other conditions being maintained constant.

2. How its accuracy depended on the potential difference at constant current and temperature.

The first of these tests was carried out at three different temperatures—namely, about 2° C., 18° C. and 40° C., which may be fairly taken as the extreme and mean ordinary working temperatures. From the results of this test the effect of change of temperature at constant potential difference and current was ascertained.

The second test is, of course, only applicable to energy meters. It was made at the maximum current and at atmospheric temperature, the pressure being varied from about 10 per cent. below to 10 per cent. above the normal value.

* Presented by Prof. W. E. Ayrton at the Toronto meeting of the British Association.

The above tests were carried out at the City and Guilds Central Technical College upon each of the following meters, obtained direct from the makers, and not opened or in any way altered before testing:

Name of Meter.	Maker's Number.	Normal Pressure.	Maximum Current.	Declared Constant.
Elihu Thomson	80,711	100	10	1.0
Schuckert	10,717	110	15	0.5
Ferranti	17,876	..	25	1.0
Perry	401	..	20	2.0
Chamberlain and Hookham	6,973	..	25	1.0

These, it will be seen, fairly represent the principal types of direct-current meters now in general use in this country.

Apparatus and Method of Testing.

In carrying out these tests it was necessary to have some means of controlling the temperature of the air surrounding the meter, and for this purpose a thermal case of the following construction was employed:

The inner tank T_1 (Figure 1) is of copper, 14 inches square by 20 inches deep, and is fixed within another similar tank T_2 by means of wooden distance pieces W W, leaving a space of 2½ inches be-

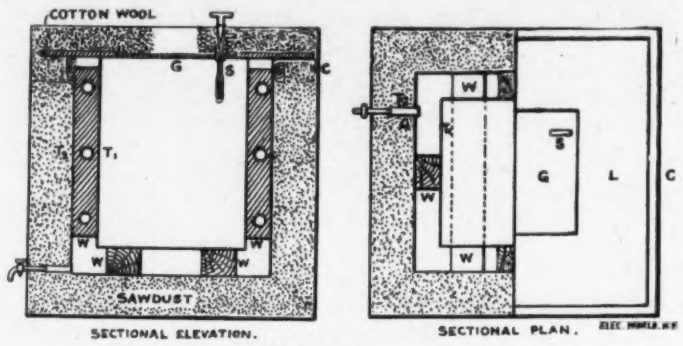


Fig. 1.

tween the two tanks at the sides and bottom; the top, however, was covered by a mahogany lid L, provided with a large window of one-fourth-inch plate glass. The whole was then placed in a wooden case 28 inches square and 32 inches high, the intervening space being filled up with sawdust to retard as much as possible interchange of heat and consequent change of temperature. For the same reason the top was covered with cotton wool, except for a small portion of the window through which observations were made.

For the higher temperature tests the space between the copper tanks was filled with water at a temperature rather above 40° C., and this was maintained constant by passing steam into the water, thus supplying heat in place of that lost by radiation, etc. The rate at which this steam was passed in was governed by a Reichert's automatic thermostat S, which regulated the supply of gas in the steam generator. Using this apparatus no difficulty was experienced in keeping the temperature of the air in the inner tank constant to within ½° C.

The low temperature, on the other hand, was obtained by substituting for the hot water a freezing mixture of salt and ice, and it was found that in this case no regulation was necessary, because after the freezing mixture had been in for several hours a steady condition was reached, after which the air in the inner tank showed no appreciable rise of temperature for two or three hours.

The intermediate temperature taken was that of the atmosphere at the time of testing, and after closing up the thermal case no greater variation occurred than in the other cases,

The rest of the apparatus and its arrangement is shown in Fig. 2, where M is the meter under test, B a battery of accumulator cells, R_1 a variable carbon resistance, and R_2 a variable mercury resistance for close regulation of the larger currents used. Currents down to 10 amperes were measured by means of a Kelvin balance previously standardized by the copper deposit method. It was not suitable, however, for currents below 10 amperes, and for such currents it was therefore replaced by the arrangement shown in Fig. 2 and consisting of a sensitive d'Arsonval galvanometer G connected in series with a variable resistance R_3 to the ends of a platinoid strip P. This arrangement, after being carefully calibrated, constitutes a very sensitive ammeter possessing the very desirable property that its sensibility can be adjusted according to the magnitude of the current to be measured. It was calibrated relatively by the

potentiometer method, and absolutely by comparison with the Kelvin balance. In the case of ampere-hour meters this completes the arrangement, but for energy meters it is necessary also to energize the shunt-windings by keeping their terminals at the proper potential difference. This was effected by means of the battery of small accumulator cells A with a regulating resistance R_4 in circuit. This potential difference was measured on an Ayrton and Mather deadbeat astatic station voltmeter. In the second set of tests, however, in which it is required to determine the effect of varying the

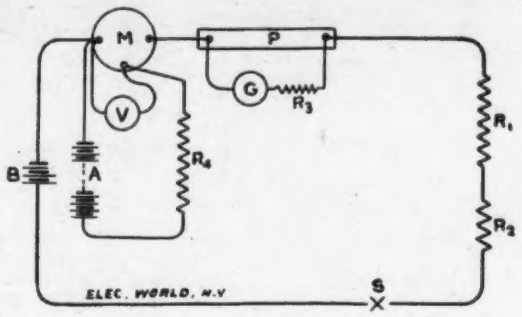


FIG. 2.

potential difference, a reflecting voltmeter of the d'Arsonval type was employed.

The accuracy of supply meters is most conveniently studied by experimentally ascertaining to what extent the constant or multiplier differs from its declared value under different conditions. By plotting the result as a curve of variation one obtains a clear indication of the behavior of the meter as regards the accuracy of its readings. The multiplier referred to is the number by which the amount indicated by the meter must be multipled to give the true value in watt hours or ampere hours, as the case may be. Hence the constant or multiplier may be defined as the ratio of the true value to the indicated value. To obtain the actual value of this constant experimentally much time and labor can be saved by observing the revolutions of the armature instead of taking the dial readings in the ordinary way, for since they are connected simply by multiplying mechanism their motions are proportional. All that is necessary is to determine once for all the number of revolu-

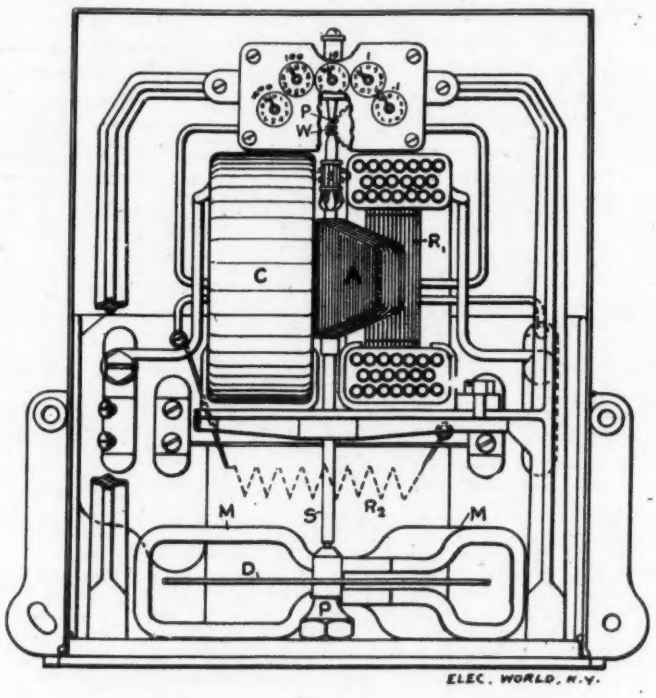


FIG. 3.

tions of the armature which correspond to the registration of one unit on the dial.

Let a = number of revolutions of the armature per unit registered on dial.

K = constant of multiplier.

A = current in amperes.

V = potential difference in volts.

T = time in hours during which A might flow.

N = number of units registered in time T.

w = speed of armature in revolutions per second.

Then $$a = \frac{3600\,wT}{N} \text{ and } N = \frac{3600\,wT}{a}$$

In the case of watt-hour meters:

By definition $$K = \frac{\text{true watt hours}}{\text{registered watt hours}} = \frac{AVT}{N},$$

substituting for N

$$K = \frac{AVT}{3600\,wT} = \frac{a}{3600}\,\frac{AV}{w},$$

and $$w = \frac{a}{3600\,K}\,AV.$$

If K' = the declared value of K,

w' = speed of armature when the meter is registering accurately,

$$w' = \frac{a}{3600\,K'}\,AV$$

$$\frac{K}{K'} = \frac{\frac{a\,A\,V}{3060\,w}}{\frac{a\,A\,V}{3600\,w'}} = \frac{w'}{w}$$

$$K = K'\frac{w'}{w}$$

The constant a having been first carefully determined, values of w' for different currents are calculated and tabulated or plotted for use.

Exactly the same method is applicable to ampere-hour meters, the only difference being that the quantity V does not occur.

In testing, therefore, there are in general three quantities to be measured, viz., current, potential difference and speed, the constant a being of course determined once for all for each meter.

The current and potential difference were measured and regulated as already described; the speed of the armature was observed by noting, by means of a stop-watch, the time taken for a convenient number of counted revolutions. The interval of time measured was never taken less than five minutes, so that the percentage error in w would be very small. In all cases the meter was allowed to run for a minute or two after each change of speed before any observation was taken, and the determinations of k for each point were repeated until concordant results were obtained.

ELIHU THOMSON METER.

This meter may be regarded as a form of electro-dynamo meter so arranged that, instead of merely indicating power it integrates it with regard to the time, and so measures the amount of energy that has passed. The general principle of all such meters is that a small fraction of the power to be integrated is employed to produce motion in an armature. If the velocity of the armature can be made exactly proportional to the whole power, then the number of revolutions of the armature in any time is a correct measure of the total energy that has passed.

In Fig. 3 C C are two coils of thick conductor, which carry the main current. The field thus produced is proportional in strength to the current, and in it is placed the armature A, which is drum wound, without any iron in its core; its windings form part of the high resistance pressure circuit. Since there is no iron in the magnetic circuit, the driving torque thus produced is proportional to the product of current and pressure, and if the retarding torque could be made strictly proportional to the speed, this would be sufficient; but solid friction at the bearings introduces a disturbing effect which is overcome, first, by making the bearing friction as small as possible, and also by compensating what remains by means of a permanent driving torque, in addition to that already mentioned. Solid friction may be considered as being very nearly constant throughout the range of speed employed. So the extra driving torque must be independent of the speed. It is produced by placing two fixed coils, R_1 R_1, of fine wire in the pressure circuit, and by connecting this circuit to the lamp side of the series coils, so that both the shunt and main currents pass round these windings (Fig. 4). The pressure circuit then consists of these two fixed coils, the armature, and an added non-inductive resistance, R_2, which brings the total to above 3000 ohms. As the meter is designed for use on either direct or alternating-current circuits it is important that the self induction of the pressure circuit should be comparatively small, consequently the non-inductive part, R_2, forms the greater part of the whole resistance. Connection is made with the armature windings by means of a small silver com-

mutator, *E*, at the top, and two lightly-pressing spring brushes, *B B*, with silver contact pieces. Fixed to the spindle at its lower end there is a large copper disc, *D*, rotating in a non-uniform but constant magnetic field, supplied by two or three permanent magnets, *M M*. The reaction between the Foucault currents induced in the disc and the magnetic field producing them gives the required retarding torque proportional in magnitude to the velocity. The counting mech-

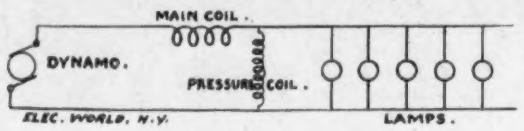


FIG. 4.

anism gears into a worm on the spindle at its upper end; the dials are usually direct reading in kilowatt hours, but in some sizes multiplication by a simple constant is necessary. In this meter solid friction is reduced to a minimum by having a delicate jeweled bearing, *P*, at the lower end of the spindle. It is provided with a spring arrangement to prevent injury from vibration, and it can be lowered out of contact when the meter is being moved. Very light pressure of the brushes is sufficient to give good electrical contact, and the upper bearing is, of course, unimportant, being little more than a guide. What solid friction remains is in great part neutralized by the permanent torque already referred to.

The law of this meter is comparatively simple, and may be expressed as follows:

Let A = main current
V = potential difference.
w = speed of the armature.
a = a constant depending on windings, etc., of series coils.
b = " " " armature.
c = " " " coils R_1 R_1.
p = " " " solid bearing friction.
f = " " " brake field.

Then Driving torque $= aAbV + cVbV$.
Retarding torque $= f^2w + r$.

For steady motion

$$abAV + bcV^2 = f^2w + r.$$

Now if bearing friction is exactly compensated by the permanent torque

$$bcV^2 = r,$$

and

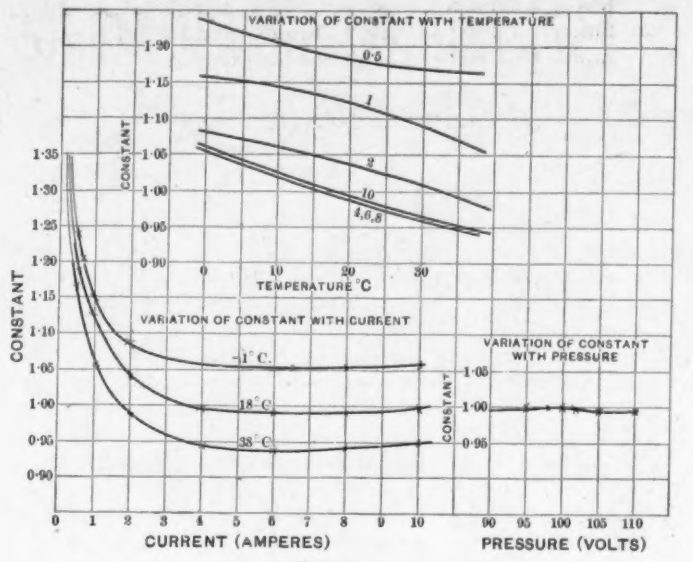
$$AV = \frac{f}{ab}w.$$

The results of the tests on this meter are given in Table I, and shown graphically in Curve 1. The starting current, below which, of course, the constant is infinite, is about 0.14 ampere or 1.4 per cent. of the maximum. The constant then falls very rapidly as the current increases; not, however, reaching its normal value till the current has risen to about 40 per cent. of its maximum value, after which it remains remarkably constant till within 10 per cent. of the maximum, when it begins to rise slightly. This high value of the constant at small current is, of course, due to the uncompensated part of the solid friction. There are several reasons why it is desirable to not quite compensate for all the solid friction. Not only would it increase the amount of continuously absorbed energy, but the meter would be liable to start without any series current should the pressure increase slightly. Another consideration is that it is very desirable to keep the self-induction of the pressure circuit as low as possible, in order to lessen the difference which it causes between the direct current and alternate-current readings.

The effect of temperature change is also shown on Curve 1, Except for low currents, where the value of the constant is not so well defined, these curves are practically straight lines. The constant decreases proportionately to the rise of temperature, and the temperature coefficient of the meter is therefore negative. Its maximum value is about — 0.32 per cent. per degree C; but for currents between 4 and 10 amperes its mean value is — 0.29 per cent. per degree C. This coefficient, it will be noted, is not very much less than that of copper, and it may therefore be surmised that the coefficient of the pressure coil is very much less than that of the copper disc.

The tests made with varying pressures show that the accuracy of the meter's indications is quite independent of the pressure when varied within 10 per cent. of the normal value.

This meter possesses some very useful advantages compared with meters generally. It is comparatively simple in construction, and is equally applicable without any modification to either alternating or direct-current circuits. As already pointed out, its constant is remarkably accurate for currents above 40 per cent. of the maximum; for low currents, however, the error is considerable. The power absorbed is also fairly large; the pressure circuit takes 3.2 watts, and the series coils at full load 9.6 watts, so that at full load the wasted



CURVE 1.

power is 1.28 per cent. of the maximum power, and at no load about 0.32 per cent.

SYMBOLS USED IN THE TABLES.

w = speed of armature in revolutions per second.
K = constant (determined experimentally).
K^1 = declared constant.
A = current in amperes.
V = potential difference in volts.
a = number of revolutions of the armature per unit registered on the dials.

TABLE I.—ELIHU THOMSON METER.

Maximum Current, 10 amperes. Pressure, 100 volts. $a = 2$. $K^1 = 1$. Current varied.

Current A.	At - 1°C.		At 18°C.		At 38°C.	
	w	K	w	K	w	K
0.5	0.0225	1.236	0 0234	1.186	0.0237	1.17
1	0.0483	1.150	0.0492	1.1x9	0.0526	1.055
2	0.1028	1.081	0.1070	1.040	0.1132	0.983
4	0.2106	1.056	0.2241	0.993	0.235	0.945
6	0.3160	1.055	0.3360	0.994	0.354	0.942
8	0.422	1.056	0.448	0.991	0.471	0.945
10	0.523	1.061	0.556	1.000	0.585	0.951

TABLE IA

Pressure varied. Current = 10 ampheres.

V	w	K
90	0.501	0.999
95	0.528	1.000
98	0.546	0.999
100	0.556	1.0 0
102	0.567	1.000
105	0.586	0.997
110	0.612	0.999

(To be continued.)

Trolleys Down, or Lamps Burning.

BY JAMES. F. HOBART.

In every barn or shop there should be one invariable inflexible rule regarding cars, and that is: "All cars not under repair shall have the trolley pole tied down and all cars with trolley up shall have lamps burning." This rule faithfully carried out will prevent many an accident, and save more than one man from getting hurt. It is a common sense rule, and a vital one for street railway shops, so much so that it should be made a universal rule, and printed notices to that effect posted prominently in every shop and barn in the world that uses electric cars with trolleys.

ANNUAL MEETING OF THE

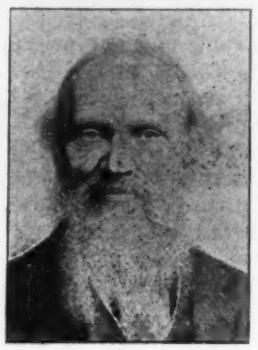
British Association for the Advancement of Science

TORONTO, AUG. 18-25, 1897.

ELEC WORLD N Y

The sixty-seventh annual meeting of the British Association for the Advancement of Science, and its second meeting outside of the British Isles, was held at Toronto, Ont., beginning August 18 and ending August 25.

The attendance of European members was large and representative, and there were also present many American men of science, including a number of well-known electrical engineers. The American Association for the Advancement of Science adjourned its session in time to permit its members to take part in the interesting deliberations of their British confreres. Fine weather and an attractive programme added greatly to the pleasure of the occasion.



LORD KELVIN.

The British Association, like its American namesake, is divided into a number of sections, including nearly all subjects of interest in the various branches of physical and natural science, as well as pure mathematics and economics.

The sections of especial interest to electrical engineers are those of Mathematical and Physical Science (theoretical), known as Section A, and Mechanical Science (practical), designated Section G.

The president of Section A at the Toronto meeting was Prof. A. R. Forsyth, of Trinity College, Cambridge; vice-presidents, Lord Kelvin, Dr. G. W. Hill, Professors Oliver Lodge, W. E. Ayrton, G. C. Foster, O. Henrici, A. Johnson, James Loudon, A. A. Michelson and Simon Newcomb.

Section G was presided over by G. F. Deacon; vice-presidents, Professors W. E. Ayrton, H. T. Bovey, John Galbraith, G. Lanza, and W. C. Unwin.

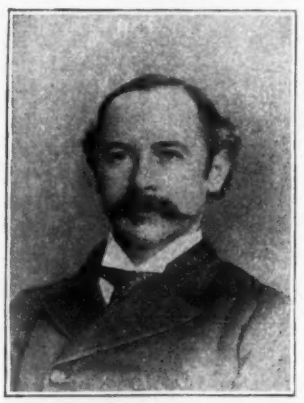
Among the papers of electrical interest presented at the meeting were the following: "On a Method of Determining the Specific Heat of a Liquid in Terms of the International Electric Units," by Prof. H. L. Callender and H. T. Barnes; "On the Fuel Supply and Air Supply of the World," by Lord Kelvin; "An Experiment with a Bundle of Glass Plates," by Prof. S. P. Thompson; "A Tangent Photometer," by Prof. S. P. Thompson; "On Zeeman's Discovery of the Effect of Magnetism on Spectral Lines," by Prof. O. Lodge; "New Varieties of Cathode Rays," by Prof. S. P. Thompson; "On the Constitution of the Electric Spark," by Arthur Schuste; "An Electric Curve Tracer," by Prof. G. B. Rosa; "Oscillographs," by W. D. B. Duddell; "On the Source of Luminosity in the Electric Arc," by Henry Lerew and Mr. Basquin; "On the Use of the Interferometer in the Study of Electric Waves," by G. F. Hull; "On the Calculation of the Coefficient of Mutual Induction of a Circle and Co-Axial Helix," by Prof. J. V. Jones; "On a Determination of the Ohm Made in Testing the Lorenz Apparatus of the McGill University," by Prof. W. E. Ayrton and Prof. J. V. Jones; "On the Use of a Constant Total Current Shunt with Ballistic Galvanometers," by Prof. W. E. Ayrton and J. Mather; "The Sensibility of Galvanometers," by Prof. W. E. Ayrton and J. Mather, "Short versus Long Period Galvanometers for Very Sensitive Zero Tests," by Prof. W. E. Ayrton and J. Mather; "On a Simple Modification of the Board of Trade Form of the Standard Clark Cell," by Prof. H. L. Callender and H. T. Barnes; "On the Cyclical Variation, with Temperature of the E. M. F., of the H Form of Clark's Cell," by F. S. Spiers, F. Twyman and W. L. Waters; "On Some New Forms of Gas Batteries and a New Carbon Consuming Battery," by Willard E. Case; "On the Determination of the State of Ionization in Dilute Aqueous Solutions Containing Two Electrolytes," by Prof. J. G. MacGregor.

Prof. W. E. Ayrton read a paper on "Some Tests on the Variation of the Constants of Electricity Meters with Temperature and Current," by G. W. Donald Ricks, of which the first installment appears in this issue of THE ELECTRICAL WORLD. This paper formed the subject of a long and interesting discussion. The general consensus of opinion seemed to be that while electric meters registered more accurately than gas meters, there is still much room for improvement in them, and that there is a great demand for a meter which will do the work well and accurately and can be sold at a price lower than that now charged.

A paper by Mr. Granville C. Cunningham, who has recently resigned his position at the head of the Montreal street railway system to take charge of the electric railways in Birmingham, England, was also read. Other electrical papers presented were: "On The Use of the Trifilar Suspension in Physical Apparatus," by Prof. S. P. Thompson; "The Effects of Tension and Quality of the Metal Upon the Changes in Length Produced in Iron Wires by Magnetization," by B. B. Brackett; "On a Research in Thermo-Electricity by Means of a Platinum Resistance Pyrometer," by H. M. Tory; "On Magnetic Periodicity as Connected with Solar Physics," by Arthur Harvey; "The Cause of the Semi-Annual Inversions of the Type Solar Curve in the Terrestrial Magnetic Field," by Prof. Frank H. Bigelow; "Observations at Toronto with Magnet Watch Integrator," by Prof. Frank H. Bigelow.

At one of the meetings of the physical section a description of the Tesla oscillator was read and discussed, favorable comment upon the machine being made by Lord Kelvin and others. At the same session an account of the new carbon-consuming batteries of Mr. Willard E. Case, of Auburn, N. Y., was also read, attracting much attention.

During the sessions of the association the members were very hospitably and charmingly entertained by residents of Toronto and its vicinity, a number of charming garden parties having proved a



S. P. THOMPSON.

W. E. AYRTON.

delightful recreation to those engaged in the serious business of scientific discussion. Among these the entertainments given by President Loudon, of the University of Toronto, and Professor Mavor, the well-known political economist, were especially noted.

On Saturday many of the members and associates paid a visit to Niagara Falls, where they were warmly welcomed by the citizens and the officers of the various electrical and other industrial companies on both sides of the river.

On Wednesday, the 25th, there was an interesting discussion postponed from earlier in the session, Dr. Oliver Lodge's paper on the influence of magnets on the lines of the spectrum.

The final item on the programme was a dinner given the same

evening by the citizens of Toronto to some of their distinguished visitors. About 400 guests sat down at 8 o'clock. About 600 persons were admitted by ticket to the gallery at 9 o'clock. The speech-making began half an hour later. The Governor-General presided, and paid special tributes to Lord Kelvin, Lord Lister and Sir John Evans, and made briefer reference to James Bryce and Professor Putnam, president of the American association. Lord Kelvin, in his reply, recounted the development of submarine telegraphy, and paid a special compliment to the electrical and mechanical engineers of the United States.

A feature of the attendance was the presence of many of the most notable scientists in the English-speaking world. Among those from the British Isles may be mentioned: Lord Kelvin, who was accompanied by Lady Kelvin; Prof. W. E. Ayrton and Miss Ayrton; Prof. John Perry, Prof. Silvanus P. Thompson, Mr. Hiram S. Maxim, Mr. John Hopkinson, Prof. W. C. Unwin, Mr. Alexander Siemens, Mr. W. M. Mordey, Major-General Webber, Prof. J. A. Ewing, Prof. Oliver Lodge and Prof. J. G. Bottomley. A large number of prominent American electricians and scientists were also present, including, among others: Prof. G. F. Barker, of the University of Pennsylvania; Prof. R. H. Thurston, Prof. E. L. Nichols and Prof Frederick Bedell, of Cornell; Prof. H. S. Carhart, of Ann Arbor; Mr. Edward Atkinson, of Boston; Profs. C. R. Cross, of the Massachusetts Institute of Technology; Reginald Fessenden, of the Western Pennsylvania University; Thomas Gray, of Terre Haute; Simon Newcomb, of the Johns Hopkins University; Carl Barus of Brown University; Major-General A. W. Greeley and Prof. J. W. Langley, of Cleveland.

The Present Tendencies of Electric Tramway Traction.*

BY J. G. W. ALDRIDGE.

Tramway work is at the present time, and has been for some years past, characterized by an increasing use of mechanical traction systems. The reasons for this are obvious and self-evident. It is, however, worth while to look into the considerations that, so far as electric traction is concerned, have caused one system or another to grow into favor, noting also the inherent qualities or attributes of each, which must affect future developments.

The United Kingdom has practically 130 miles of electric tramway at work or under construction; of this length 103½ miles are operated on the trolley or overhead wire system, 15¾ miles by means of a third rail conductor, 6 miles by means of storage batteries, and only 4 miles on the underground conduit system.

These proportions may be taken as fairly representative of other countries, also, as far as can be ascertained.

They seem likely to be maintained or even increased in favor of the overhead wire system, unless radical improvements can be made in the direction of a cheaply built and maintained conduit method, or more durable and light accumulators for placing direct upon the car. Objections to the overhead trolley wire system are almost entirely aesthetic, but at the same time have such great weight and force that every incentive is offered to the genius of invention to make improvements in other directions.

The ordinary underground conduit with open slot is most expensive to install and troublesome to maintain efficiently; it cannot be built for less than £10,000 or £12,000 per mile. Even its latest form (consisting practically of an underground trolley wire) must require an outlay of nearly double the cost of an overhead wire system.

Closed conduits with surface contacts, usually operated by means of electromagnetic switching devices in boxes under the street level, are complicated, and it is to be feared are unreliable. The great weight of lead required on each car for accumulator traction means practically that the live paying load can never reach 25 per cent. of the gross weight of loaded car; while the combinations of trolley wire and battery, attempted on systems like those of Hanover and Dresden, are obviously ill-designed, the dead weight of battery being carried throughout the entire journey, though it is only required for part thereof.

The overhead trolley wire system therefore appears likely to come into still greater use than has already been the case, if only on the ground of economy; but in view of its admitted defects, the author has worked out an alternative method which avoids the erection of trolley wires along the streets above the tracks.

*Abstract of a paper read at the Toronto Meeting of the British Association.

A New Method of Investigating the Variation of the Magnetic Qualities of Iron with Temperature.*

BY F. H. PITCHER.

[Communicated by Professor H. L. Callender, M. A., F. R. S.]

Owing to the apparent lack of exact knowledge on the subject of the variation of hysteresis in iron with temperature, and as it is of some importance in the working of transformers, it was thought well to investigate the subject further.

At the same time it was intended to repeat the experiments of Hopkinson and others on magnetism at high temperatures, by a different method and with higher fields. For this purpose a new method, devised by Professor Callender, was employed.

DESCRIPTION OF THE METHOD.

The specimen of iron in question was in the form of a wire and was tested by the direct magnetometric method in the broad side-on position. The first intention was to insulate the specimen in a small and very thin platinum tube, heated by having a current passed through it. The temperature of the specimen was to be inferred from the resistance of the platinum tube over the length occupied by the iron wire specimen. The resistance was to be measured by the fall of potential between the terminals of very fine platinum wire leads, attached to the platinum tube at the ends of the above length.

In this way, if the tube were made considerably longer than the wire, the middle portion occupied by the wire would be very uniformly heated, and very exact values of the mean temperature could be obtained. The slack of the platinum tube, when heated, was arranged to be taken up by copper springs. To prevent oxidation of the iron wire specimen, and at the same time to promote a steady temperature throughout the length of the platinum tube, the whole was inclosed in a vacuum tube. The vacuum was maintained by a five-fall Sprengel pump, which was kept running during the experiment and was assisted by a water pump in the early stages of exhausting the tube.

With this method in view, a platinum tube was constructed from a strip of foil 20 cm long, 2.95 cm wide and 0.00254 cm thick. It was rolled around a mandrel 0.438 cm diam., and after annealing kept its dimensions without necessitating binding wires. The fine platinum leads were attached by winding their ends once around the tube and twisting up tight. A specimen of iron wire was threaded through mica wads of the same diameter as the mandrel, and slipped into position inside the platinum tube. The ends of the platinum tube were bound with bare copper wire to No. 0 copper rods, and the whole carefully centred in a glass tube.

The tube was exhausted, and a preliminary test for uniformity of heating made before placing it in the solenoid. It was seen to be heated very uniformly up to 2 cm from each end. The apparatus was then fixed in position in the solenoid, and the whole placed in position with respect to the magnetometer. It was found, however, that platinum tubes constructed in this manner from thin foil would not stand at high temperatures. Two others were tried, which, on account of not having thicker foil of sufficient length, had to be constructed out of foil of one-half the thickness—one being wound three times around the mandrel, and the other five times. These shared the same fate as the first one, giving way in circular cracks running sometimes over one-half the width of the foil.

The initial extension of the copper springs was not more than 2 mm in any case, and the ends of the tubes made as square as possible so as to equalize the tension. This method was therefore abandoned until drawn tubes of suitable thickness could be obtained. In the meantime the platinum tube was replaced by the iron wire specimen itself, and in this way observations were obtained, and, by making the specimen its own thermometer, very exact values of its temperature could be obtained.

By heating the specimen in this manner there would be a strong circular field due to the heating current. The curves plotted from the temperature and magnetometer readings would therefore have to be corrected for this circular magnetism. This was effected in the manner explained, which, however, limited the temperature to which the wire could be raised. A set of observations was taken with the specimen in air and another in a high vacuum. The true magnetic behavior of the iron with temperature could then be obtained from these two sets.

DESCRIPTION OF APPARATUS.

The Solenoid.—The magnetizing coil is made in the laboratory was wound on a brass tube about 70 cm long and having an outside

*Abstract of a paper read at the Toronto Meeting of the British Association.

diameter of 2.23 cm. The tube was fairly straight, and previous to winding was filed up and polished in a lathe and then carefully lacquered.

Winding—

Length of winding	60.25 cm.
Depth of winding (four layers double silk covered No. 24 B. and S.)	0.245 "
Whole number of turns	4079.0 "
Total resistance	28.1 "

This winding was fed on by hand in a lathe, and was very fairly uniform. Each layer was carefully paraffined before winding the next. The insulation resistance when finished, as tested on 100 volts, was over a megohm. The winding was backed up at the ends by square ebonite washers, which were fixed to the tube by brass set screws.

The Water Circulation.—A water circulation was arranged for dissipating the heat when large magnetizing forces were used. A thin brass tube was chosen, so that if it were slipped into the solenoid tube the annular space between them would be about 2 mm. The smaller tube was centred by brass rings fitted at the ends to the annular space between the tubes. The joint was made tight by soldering. The water circulation was effected by two small brass tubes, about 0.75 cm diameter, entering laterally through the solenoid tube beyond the ebonite end into the spaces between the tubes.

Combined Galvanometer and Magnetometer.—This instrument was simply a mirror galvanometer, mounted on leveling screws, and with two coils of copper wire fitted closely on each side of the needle. The instrument was made fairly dead beat by employing a large thin aluminum vane, just fitting the needle chamber, to carry the mirror and needle. The resistance of the coils was found to be 100.3 ohms at 18°.7 C. It was used for measuring currents and resistances by the fall of potential method. The direct effect of the solenoid was balanced in the usual way by a balancing coil.

The Mounting for the Iron Wire Specimen.—The iron wire specimen was 26.1 cm long and 0.127 cm diameter. Its ends were fused to copper wires 10.5 cm long and 0.40 cm diameter, an arrangement intended to conduce to a constant temperature throughout the length of the iron wire when the heating current was passed through the circuits. The ends of the copper wire were riveted and tin-soldered to two No. 0 B. & S. copper rods, which were brought out at both ends of the containing tube. The rods were at about 6 cm from their inside ends, and copper springs, three strands No. 18 B. & S., wound oppositely, were introduced to take up the slack of the specimen and copper wires when heated. The springs fitted the inclosing glass tube fairly well, but better centering was obtained by brass washers soldered on the 6 cm. segments at about 5 cm apart and turned up to fit the tube.

Two fine platinum wires, for potential leads, were attached at 15 cm apart to the iron wire specimen. They were brought out in glass capillary tubes running through diametrically opposite holes in the washers and inside the springs to one end of the glass-containing tube. The ends of the capillary tubes were allowed to protrude about 5 cm beyond the containing tube, and were fused at both ends to the platinum wires.

The diameter of the platinum leads was 0.005 cm; total length, 98.0 cm; resistance, 8.06 ohms.

The glass-containing tube was made tight at the ends in the following manner: At the end where the capillary tubes were brought out a large brass cup, 2 cm deep and 2 cm internal diameter, drilled through the bottom to fit the rod and capillary tubes, was threaded over into position and soldered to the rod. This tube just fitted the inner solenoid tube, and had an internal diameter of about 1.27 cm. It was slipped over the apparatus till its end reached the bottom of the cup. The cup was then filled with melted fusible alloy, and to make tightness double sure a mixture of beeswax and resin was run around all the joints. The other end of the glass tube was drawn down so as nearly to fit the copper rod, and a similar but, on account of having to go through the solenoid tube, smaller cup soldered to the rod, after putting a small initial extension of about 2 mm in the springs.

The seal was made in the same way as before. The connection to the pump was made by means of a small copper tube entering through the bottom of the brass cup and sweated in with solder. It was bent up at a right angle to facilitate a mercury immersion joint. The length of glass tube between the cups was 61 cm which was about 2 cm longer than the inner brass tube of the solenoid.

When the apparatus was in place so that the specimen was symmetrical with respect to the solenoid the small brass cup was just at the end of the inner solenoid tube. Three brass set screws, ranged symmetrically, were tapped through this end of the solenoid tube and screwed down hard on the cup. At the other end of the solenoid tube a brass binding screw was soldered. This, with a similar screw on the adjacent end of the copper rod, formed the heating current terminals. By making the heating current return around itself in this way, its direct effect on the magnetometer was minimized.

A compressed fibre block was screwed to the copper rod near the ends of the capillary tubes, and vertical holes drilled side by side in it, to form mercury cups for the platinum leads. Twin-wire leads of approximately equal resistances were brought from the terminals of the standard resistances in the magnetizing and heating current circuits, together with a similar pair from the mercury cups at the ends of the platinum potential leads, to three pairs of mercury cups on the table near the telescope and scale. The readings for magnetizing current, heating current, and E. M. F. over the specimen could be very conveniently and quickly obtained by dipping the ends of the galvanometer leads into each pair of cups in turn.

A Telegraph Line to the Klondyke.

The Canadian Government has submitted formal proposals to this Government to establish communication with the Klondyke region in Alaska by the construction of a telegraph line from the head of winter navigation on the Lynn Canal to the centre of the Klondyke region. The proposals have been taken under advisement. They have been approved by the British Principal Secretary of State for Foreign Affairs, and were forwarded by the Governor-General of Canada through the British Embassy to the State Department, and referred to the Interior Department. The papers are locked up pending consideration. The proposals, while reserving the right of either country pending the settlement of the international boundary line between the United States and Canada, south of Mt. St. Elias, urged the expediency of establishing a permanent route giving access to the interior at all seasons of the year. The most feasible route, according to the Canadian authorities, would be to start from the head of the navigation in the winter on the Lynn Canal (the body of water running from Juneau up beyond Dyea and Chilcat, forming part of the present overland route, crossing the mountains by White Pass, or by any other pass which may seem more accessible, and proceed northward to Fort Selkirk, and thence to Klondyke. The Canadian Government asserts its readiness to undertake to open communication by constructing a telegraph line from the head of winter navigation on the Lynn Canal, traversing a distance of 80 miles across the summit of the mountain range to a convenient point northeast of the mountain range from which a trail can be followed to Fort Selkirk and Klondyke. The Government also signifies its intention, in case the propositions are adopted, to erect suitable places for shelter at periods from 40 to 50 miles along the line, and to keep up dog trains during the months of winter for the conveyance of the mails to and from the interior.

An Important Telephone Decision.

The decision of Judge Nathan P. Goff, of the United States Circuit Court, was handed down at Richmond, Va., last Wednesday, perpetuating the injunction against that city in favor of the Bell Telephone Company. Judge Goff several months ago restrained the city by injunction from removing the poles and wires of the company from its streets when the franchise had expired. The grounds upon which the telephone company fought the city was that their system was a part of the interstate commerce system of a general telegraph. Judge Goff's decision will affect every city where the Bell Company is operating, and it is probable that this means the retention of the Bell system in cities where there is objection to it.

A Straight Line Relation for Fuse Wire.

A French electrician, M. Laporte, found that if the lengths of fuse wires are made the abscissas and the fusing currents the ordinates, the diameter remaining the same, the curve will be approximately an equilateral hyperbola. For different diameters the curves will be similar, but their axes will be longer. It follows from this that if the reciprocals of the lengths be taken instead of the lengths themselves, this relation can be represented by straight lines.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS BY CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Multiple-Circuit Dynamos. KENNEDY. Lond. *Elec. Rev.*, Aug. 13.—A note referring to the recently described Rushmore dynamos and stating that he had patented this method as early as 1882; it has been re-invented and patented several times since. He claims that for ordinary work there is little advantage in the arrangement.

Transformer Design, Construction and Test. CARHART. *Elec. Eng.*, Aug. 19.—An abstract of a paper giving the details of the construction of a transformer built and tested by students, to determine how nearly theory dictates correct practice. The transformer is of the core type; the data for the construction are given and in conclusion a comparison between the observed and the calculated values of the resistance losses and efficiencies are given, showing very good agreement, the greatest difference being in the iron losses, in which the computed values were about 14 per cent. too high.

LIGHTS AND LIGHTING.

Non-Interchangeable Lamp Sockets.—Elek. Anz., Aug. 8.—A brief illustrated description of those used by a German company for cases in which the charge for current is based on the number of lamps; the arrangement prevents a high candle-power lamp being inserted in a socket intended for one of a lower candle power. In the usual screw-thread socket, brass tubes of different lengths prevent the bottom contact of the base from touching the corresponding contact in the socket unless the lamp is constructed with the proper proportions; a high candle-power lamp will therefore not burn when inserted in a socket intended for one of lower candle power.

Train Lighting. JACQUIN. *L'Eclairage Elec.*, July 31.—The beginning of what appears to be a very full description of the plant in use on the Jura-Simplon railway.

POWER.

Power Transmission at Genoa. FRIEDMANN. *L'Elec.*, July 31 and Aug. 7.—The beginning of an illustrated description of this transmission plant, in which the continuous-current series system is used, the stations being placed at successive falls; some of these have been in operation for a number of years. Other descriptions have already been noticed.

Applications of Electric Energy in Agriculture. RENAUD. *L'Eclairage Elec.*, July 31.—A long abstract, with numerous illustrations, from a recent paper, giving the results of tests made in a number of different installations in France (each of these installations has already been referred to in these columns).

Floating Current Motor.—Elek. Anz., Aug. 5.—Illustrated descriptions of a form of motor to be placed in navigable streams and intended for generating energy; the arrangement is such that the temporary wier is placed completely across the stream but can readily be moved away to allow vessels to pass; a table of the calculated powers is given.

TRACTION.

Accumulator Traction at Nice.—L'Energie Elec., July 1.—A description, with data, of this line, which has been running for about a year. The length is 2.5 miles and there is a long grade of 6 to 7.5 per cent.; the speed, except on the grade, is 10 to 12 km per hour; there are 10 sets of batteries of 80 cells each; they weigh 20 kg each and are of the Julien type; the normal charging current is 20 amperes and the discharging 70, that is 3.5 amperes per kg, the capacity being 150 ampere hours; the charging takes five to six hours; each battery makes two round trips with one charge; one trip takes from 50 to 60 ampere hours; the cost of maintenance has been much less than what was expected.

Electric Brakes.—Zeit. fuer Elek., Aug. 1.—A note stating that there are 200 of these brakes in use at Dresden and that they give very satisfactory results; they act on those axles which have no motors and are used on the motor car as well as on the trailer; tests showed that a loaded motor car and trailer whose speed was 25 km per hour came to rest at 14 meters; with the hand brake, although the speed was only 20 km the distance was 35 meters, that is, it required about three times as much time. On the electric line in Berlin the cars are provided with switches for short-circuiting the motors, thus obtaining their braking action; at the usual speed they are brought to rest in 8 meters, which is a very good result.

Test of a Conduit System.—L'Elec., July 31.—A brief account of the tests made at Hamburg with the well-known Lachmann system; these tests have been noticed before in these columns; they are claimed to have shown that the presence of water in the conduit does not affect the proper operation of the system; the cost is said to be $10 per meter (but it is not stated what this includes); an experimental line 600 meters long is to be constructed in Vienna.

Electric Railways. PELLISSIER. *L'Eclairage Elec.*, July 31.—The beginning of a profusely illustrated article describing apparatus, systems, etc., many of which appear to be of American origin.

Economy in Controller Handling. CRAVATH. *St. Ry. Rev.*, Aug. 15.—A contribution to the recent discussion; he claims that in this discussion a number of elements which influence the results in practice have not been taken into consideration and that the discussion was too theoretical; he brings out the practical points involved, showing how the question affects the coal pile; he does not favor the rapid turning on of the current; when turned on fast the increased accelerating efficiency of the series-parallel control is partly thrown away; when the motors are thrown from series to multiple the horizontal effort per ampere of current is reduced one-half; the loss in feeders and the trolley wires being proportional to the square of the current, becomes much greater by rapid controller advancement; the field shunt is liable to be cut in two too soon, thus lowering the accelerating efficiency; the maximum load is increased, thus requiring more generating machinery to be kept running; the motorman will slip the wheels on nearly every start; the motors are heated much more rapidly; finally, actual tests and trials show that it is not economical to advance the controller too rapidly. He recommends letting the car drift as much as possible with the current shut off.

Feeder Lines.—St. Ry. Rev., Aug. 15.—Data and brief descriptions, including a large map for the Toronto railways, of the systems of feeder wires used by a number of different electric railways; notwithstanding the large investments in feeders it is claimed that many of the feeder systems do not perform the functions expected of them because they are worked beyond the proper limits.

Conduit Railway in New York.—Elec. Eng., Aug. 19.—Illustrations, accompanied by a brief description, of the conduit railway which is being laid by the Metropolitan Company in New York on Eighth and Madison Avenues.

Power House, San Francisco. HANSCOM. *Jour. of El'ty*, July.—An illustrated description of the power house of the Market Street Railway Company, known as the Bryant Street Power House.

Submarine Navigation. HOLLAND. *Cassier's Mag.*, Aug.—A long article giving an illustrated history of the various attempts made to construct submarine vessels, describing the correct principles and concluding with a brief description of the author's boat, which is now being built by the United States Government (more detailed descriptions of the latter have already been noticed in these columns).

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Voltmeter Switch for Accumulators.—L'Eclairage Elec., July 31.—An illustrated description, taken from a recent paper by Planzol, describing a form which is in use in a large number of installations in France. The terminals of each cell lead to contacts on a switchboard with a radial arm, by the movement of which over the contacts, the voltage of each cell may be measured in rapid succession.

Frankford.—Elec. Eng., August 13.—An abstract of the report of accounts of that station for the year ending last March. The station is of interest because it has a large motor load, although the single phase alternating current system is used.

Distributing Systems.—Lond. *Elec.*, Aug. 13.—A reprint, with an editorial discussion, of the two Municipal Association papers by Blaikie and Jeckell, which were noticed before in these columns.

Prices for Electrical Supplies.—West. Elec., Aug. 21.—A tabulation of the bids for supplying electrical apparatus to the Government Printing

Office; the name of the bidder and the price is given for each of a large number of pieces of apparatus.

Municipal Control.—Prog. Age, Aug. 16.—A rejoinder by Grout to the recent article of Foote and an editorial discussion of it.

WIRES, WIRING AND CONDUITS.

New Wiring Rules.—Lond. *Elec.* and *Elec. Eng.*, Aug. 13.—A reprint of the new rules of the Institution of Electrical Engineers. In a brief editorial notice in the former journal it is stated that the insurance companies could not agree with the committee of the Institution, and therefore each issued its own rules; besides the Institution rules and those laid down by the various central stations and municipalities, there are at least three sets of insurance companies' rules in force in England; there are radical differences between the new Institution rules and their predecessors, the chief ones referring to cable specifications and to the authorization of interior conduits if they are incombustible; the cable specifications differ greatly from those in other existing regulations, but they were determined by a committee of "most expert experts"; the values in the table for the maximum currents are lower than those in the well-known table of Kennelly; the drawing-in system is recommended; casing is practically restricted to surface work and under flooring; the system of spacing insulating conductors away from walls on the insulators is not admitted unless the conductors are mechanically protected throughout; it is thought in the editorial that the committee has succeeded in compiling the best set of house-wiring regulations that have been published and it is recommended that they be generally adopted.

ELECTRO-PHYSICS AND MAGNETISM.

Curious Alternating-Current Arc Phenomena. HAY. Lond. *Elec.*, Aug. 13.—The maintenance of an alternating arc between metallic electrodes is very difficult and when the electrodes become very hot the arc generally goes out; it will then be found impossible to re-establish it while the electrodes are at a red heat. Under these circumstances and with iron electrodes he found that if a jet of hydrogen be directed into the space between the two electrodes while their ends are still at a bright red heat, the smooth well rounded surfaces of the ends become contorted, and tenticles or processes gradually swell up and advance to meet each other; when they meet the arc is suddenly re-established and the protruding portions instantly disappear; this lasts for a second or two, when the arc goes out, the same process being repeated; the growth of the processes takes from 3 to 5 seconds and proceeds only above a certain temperature; no effect is produced when the hydrogen jet is removed; coal gas was also tried, but the adjustments were much more troublesome; the iron rods were 11 mm in diameter and the arc was from 3 to 5 mm in length, the current being 16 amperes and about 30 volts; it was obtained from an alternator whose maximum E. M. F. (meaning the peak of the wave), on open circuit was about 350 volts; if the switch is opened immediately after the extinction of the arc the incandescent tips of the electrodes will still swell and approach each other, showing that the effect does not depend on the feeble electrostatic action between them; the crusts formed at the extremities were found to consist of porous masses; a similar effect was obtained with copper electrodes, but the extinction and establishment of the arc were extremely rapid.

Resistance of Salt Solutions in Motion. BOSE. *Zeit f. Elektrochemie*, Aug 5.—In order to decide between the correctness of the hypotheses of Hittorf and Arrhenius, he made the measurements and obtained the results that with electrolytes in which a concentration is produced at the positive pole by the current the resistance increased when the flow of the liquid was against the current, and vice versa; when the concentration is at the negative pole the resistance becomes less when the flow is in the opposite direction to the current.

Resistance of Conductors for Variable Currents. BRYLINSKY. *L'Eclairage Elec.*, July 24.—The conclusion of his long mathematical series. In conclusion he states that the hollow conductor has not been found to be needed in practice on account of the use of transformers, and in telephony on account of the abandonment of iron and very long lines; if hollow conductors are to be resorted to the formulas which he gives will give a complete solution of the problems, but the calculations are not simple.

Electric Distribution on the Surface of a Ring. BOULGAKOFF. *L'Eclairage Elec.*, July 31.—A highly mathematical article in which he deduces the same results as Neumann did, but in a different way.

Absorption of Electromagnetic Waves. RIGHI. *Nuovo Cimento*, June; abstracted briefly in the Lond. *Elec.*, Aug. 13.—He describes simple and effective experiments with slabs of dielectrics placed at an angle in front of the mirror in order to separate the transmission and the absorption effects of electromagnetic waves. Wood behaved similarly to a grating of wires parallel to its fibres, but the absorption is not total.

Origin of the Coherer.—Lond. *Elec. Rev.*, Aug. 13.—A translation of the original French Academy paper of Branly of Nov. 24, 1890.

Experiments with Röntgen Rays. VOLLAR and WALTER. *L'Eclairage Elec.*, July 31; abstracted from the *Wied. Ann.*, 61, p. 88.—They describe experiments; when the tube is exhausted as much as possible the heating effect disappears almost completely, while the Röntgen rays are still intense; the rays traverse a substance more easily the lower the pressure in the tube; neither the diamond nor copper gave appreciable refraction; they calculate a limiting value of the wave length; diffuse reflection was obtained, the largest amount being from the silver group.

Pin Hole Röntgen Ray Photographs. CZERMAK. *L'Eclairage Elec.*, July 24; abstracted from the *Wied. Ann.*, 60, p. 760.—He used a camera in which a pin hole through a sheet of lead took the place of the lens; images of the tube and surrounding objects were obtained, but they are not reproduced in the abstract; he also obtained the reflection from polished metals, but it was not a regular reflection.

Complexity of X-Rays. IMBERT and BERTIN-SANS. *L'Eclairage Elec.*, July 24.—A reprint of an Academy paper in which they describe a photometer for readily showing the condition of the tube with reference to its use for radiography.

Examination of Metals by X-Rays. RADIGUET. *L'Eclairage Elec.*, July 31.—An abstract of an Academy paper describing the application of these rays for finding imperfections and blowholes in metals; the results are given briefly.

Action of Electric Charges on the Discharge by X-Rays. VILLARI. *L'Eclairage Elec.*, July 31.—A reprint of an Academy paper in which he advances a hypothesis.

Properties of Gases Traversed by X-Rays. SAGNAC. *L'Eclairage Elec.*, July 31.—A reprint of an Academy paper; he found, as Röntgen did, that the air disseminates Röntgen rays.

Cathode Rays in the Space of the Universe.—Elek. Anz., Aug. 8.—A brief mention of the researches of Goldstein.

Electrical Influence of Crookes Tubes. COURMELLES. *L'Eclairage Elec.*, July 24.—A reprint of an Academy paper describing experiments showing some light effects.

Effect of Mechanical Blows and Heat on Magnetization. FROMME. *L'Eclairage Elec.*, July 24; abstracted from the *Wied. Ann*, 61, p. 55.—He describes experiments which show that the modifications produced in iron and steel appear to be simply magnetic and not mechanical.

The Earth a Great Magnet. FLEMING. Lond. *Elec. Rev.*, Aug. 13.—The beginning of a reprint in full of his lecture to the workingmen of Liverpool, held last September, an abstract of which was noticed in the *Digest*, Oct. 17.

ELECTRO-CHEMISTRY AND BATTERIES.

Electric Tanning. ROEVER. *L'Eclairage Elec.*, July 24; abstracted from the *Wied. Ann.*, 1896, p. 397.—The results of theoretical researches (presumably meaning laboratory experiments); he arrives at the following conclusions: That solutions of tannin which traverse the leather in small quantities under hydraulic pressure, pass in large quantities under the action of the electric current, the liquid moving in the direction of the current; in the first few minutes the action is proportional to the E. M. F. and not to the current; the quantity of liquid transported decreases during "0.2-8" minutes; by reversing the current it increases, reaching a maximum in the above mentioned time, after which it decreases again; to facilitate the circulation of the solution the current should be reversed at short intervals, as every minute for instance.

Electric Production of Nitric Acid. VON LEPEL. Lond. *Elec. Eng.*, Aug. 13.—An abstract of a recent article giving the best conditions for oxidizing nitrogen. The electrodes should be placed in the lower expanded extremity of a perpendicular glass tube having a capacity of 2 or 3 liters; the lower or cathode, is in the form of a flat plate, while the upper, or anode, is pointed; a moderately rapid stream of air is kept passing through the apparatus and a fine liquid spray is forced in from above, dissolving the nitric acid as it is formed, the acid solution being drawn off below; a solution containing "0.56 per cent." of nitric acid was obtained; the yield increases more rapidly with an increase in the current strength than with an increase in the length of the sparks; if the air is not kept in motion the nitric peroxide is destroyed almost as quickly as it is formed; the yield is affected greatly by the amount of air, the nature of the electrodes and of the liquid spray; it is increased by using liquids which act as oxygen carriers; ozonized air and Röntgen rays decrease the yield.

Recent Researches with Ozone. BLONDIN. *L'Eclairage Elec.*, July 24.—A review of the recent papers of Andreoli and of Otto. In the introduction it is stated that theoretically one hp-hour should produce 1030 grams of ozone, which is calculated from the heat disengaged by converting a molecule of ozone into oxygen; the efficiency of all present apparatus is very low, not exceeding 2 per cent., which corresponds to $1 per kg. of ozone, not including the amortization of the apparatus.

Chemical Decomposition of Sulphur. GROSS. *Elektrochem. Zeit.*, Aug.—A continuation of his article. He describes further experiments which indicate a possible decomposition of this element. He believes that by electrolysis further decompositions could be obtained than are possible with purely chemical reactions; he intends to continue his researches.

Chromium Alloys.—Elektrochem. Zeit., Aug.—A note from a French paper stating that by the addition of chemically pure electrolytically prepared chromium the properties of other metals and alloys may be improved; the chromium is added to the molten metal; other metals, such as zinc, manganese, etc., may also be added to facilitate the union; to prevent the oxidation of the chromium it is covered electrolytically with copper, zinc, silver, etc. A small amount will increase the hardness and

roughness of copper and a number of other metals; it also increases the resistance to abrasion, to the action of high temperatures and acids; the electrical resistance of nickel and manganese and the diamagnetic properties of certain metals are increased.

Zinc Plating Steel Wires.—Lond. *Elec. Rev.*, Aug. 13.—A very brief description, with illustrations, of the apparatus for the Cowper-Coles process. Wires can thus be coated to 0.003 inch and they are then capable of standing eight immersions in a saturated solution of copper sulphate; a coated wire 0.069 inch in diameter will withstand repeated bending around a bar 1 inch in diameter without exhibiting signs of peeling or cracking. It appears that a circular lead anode around the wire; the solution circulates rapidly and then passes into tanks supplied with zinc dust; a burnisher is used for brightening the deposit.

Extracting Metals From Their Ores.—Zeit. f. Elektrochemie, Aug. 5.—A brief description of the Siemens and Halske process, which consists of dry chlorination at the ordinary temperature, followed by a dissolving of the products, and then by electrolysis, from which latter operation the chlorine is again recovered.

Gold Extraction. Andreoli. Lond. *Elec. Rev.*, Aug. 13.—The conclusion of his criticism of the Cassel Gold Company's patents; he attacks the patent of James, who uses a lead anode protected with a secret material, which Andreoli claims is nothing more than lead peroxide, stating also that he himself invented this method some time ago.

Carbide Patent.—Zeit. f. Elektrochemie, Aug. 5.—A discussion of the patent question by Lux and Borchers.

Changes in the Free Energy in Forming Insoluble Mercury Compounds. St. Bugarszky. *Zeit. f. Elektrochemie*, Aug. 5.—An abstract including a large table giving the results of calculations and measurements.

Electro-Chemical Introduction of Hydroxyl Groups in Azobenzole. Heypern. *Zeit. f. Elektrochemie*, Aug. 5.—A short account of some experiments which resulted successfully.

Relations of Electro-Chemistry to Organic Chemistry. Elbs. *Zeit. f. Elektrochemie*, Aug. 5.—A review of the subject, including a discussion of the chemical reactions.

Synthesis of Organic Acids. Miller. *Zeit. f. Elektrochemie*, July 20.—A reprint of a paper read before the Electro-Chemical Society. He describes experiments made by him and Hofer.

Migration of Colloids. Coehn. *Zeit. f. Elektrochemie*, July 20.—A reprint of a paper read before the Electro-Chemical Society. In a recent paper he showed that the coloring material in several solutions is transmitted in the direction of the current and concluded that these were colored ions; he then tried to find under what conditions a movable substance followed the direction of the current in an electrolyte and concludes that the substance will move if it carries an electric charge; experiments with various colloids like tannin, caramel and starch, are described, the former being of importance in electric tanning; he shows that colloids migrate like the suspended parts in the direction of the negative current, but those which may be dissociated give different results.

Electro-Chemical Laboratory at the High School in Munich.—Zeit. f. Elektrochemie, July 20.—A description, with a number of large illustrations, of the new laboratory which has recently been opened.

Accumulator with Soluble Electrodes.—L'Eclairage Elec., July 24.—A brief description of the Lake cell; the negative electrode is zinc in caustic soda contained in a porous cup; the positive is peroxide of lead in sulphuric acid; theoretically the voltage is 3.67 and practically it is 3.2 to 3.3; (nothing is said of the difficulty of separating an acid and an alkaline solution by means of a porous cup; if this were practicable very good batteries could be constructed).

Calculation of the Capacity of an Accumulator for Variable Currents. Liebenow. *Zeit. f. Elektrochemie*, July 20.—A reprint of a paper read before the Electro-Chemical Society. After pointing out the importance of being able to determine the capacity for variable currents, such as in lighting stations, he deduces, by means of the integral calculus, a comparatively simple formula, which is that the current multiplied by the time is equal to the maximum capacity of the accumulator divided by one, plus a constant multiplied by the reciprocal of the square root of the time; the constant must be determined for each accumulator and in an example given is equal to about 1.5.

Electro-Chemical and Electro-Metallurgical Industries in Europe. Kershaw. *Elty*, Aug. 18.—A continuation of his serial (see *Digest*, last week). He describes the various industries in England and Germany.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Recording Current Curves Electrolytically. Gruetzner. *Elektrochem. Zeit.*, Aug.—A very long illustrated article describing his method and in general the application of what he calls the movable electrode. Briefly, the method appears to consist in passing the current between an electrode and a drum over which chemically prepared paper passes; the current will then form lines, from the darkness or lightness of which he then estimates the current which passed; by using two such electrodes connected to the two poles, one will draw a line for negative and the other for positive impulses. He found that the iodide of potassium starch paper was the best to use; this is prepared by boiling 4 gr. of wheat starch in 100 gr. of water and then adding 4 gr. of iodide of potassium; the paper is saturated with this and then dried rapidly in the dark, being kept free from vapors; it may be preserved in closed glass bottles. The method may be used for current impulses, extra currents, etc., and it is therefore of use in physiological researches; it is limited to voltages higher than that required for the electrolysis; it appears that the record is not very exact, as the current is apt to be drawn back by the electrode, thus forming a sort of lagging indication. In conclusion he gives quite a long description of the somewhat similar method of Janet (which was noticed in these columns some years ago); in these the current curves are drawn by uniting the ends of a large number of parallel, broken lines formed by a corresponding number of such electrodes.

Optical Method for Studying Alternating Currents. Abraham and Buisson. *L'Elec.*, July 31, and *L'Eclairage Elec.*, July 24.—A reprint of a short Academy paper describing a modification of the Crehore and of the Pionchon methods, in order to reduce them to zero methods. The rotation produced by the alternating current is compensated by means of a direct current which can be measured and at a portion of the period which is always the same, by passing a beam of light through the apparatus only at that particular moment. The glass tube contains a liquid with a high rotative power; around this are two coils with the same number of windings; there is a polarizer and a Nicol analyzer; the light is furnished by a spark from a condenser charged by an induction coil, the primary of which is connected with a cut ring fastened to the shaft of the same machine which delivers the alternating current; in this way the circuit is broken and the spark produced at the same portion of the period. The alternating current is opened and the continuous-current circuit is closed; the latter current is varied until the same illumination is produced, the current being then measured; for another point the cut ring is moved through a small angle; an illustration of a curve is given in the first mentioned journal.

Determining Dielectric Constants of Solid Bodies. Starke. *L'Eclairage Elec.*, July 24; abstracted from the *Wied. Ann.*, 60, p. 629.—The method consists in finding a mixture of liquids which have the same constant as the solid. It appears to be the same paper which was referred to some time ago; it is applicable to constants between 2 2 and 10; the results of some determinations are given.

Determining Dielectric Constants. Smale. *L'Eclairage Elec.*, July 24; abstracted briefly from the *Wied. Ann.*, 61, p. 625.—He used his electrometer with a Tesla transformer and measured the constants for salt solutions; the results found are given in the abstract.

Oscillations During the Charge of a Condenser and the Measurement of Self-Induction. Seiler. *L'Eclairage Elec.*, July 24; abstracted at some length from the *Wied. Ann.*, 61, p. 30.—An abstract of what appears to be the same paper that was noticed some time ago.

Measurement of Electric Power and Energy. Armagnat. *L'Eclairage Elec.*, July 24.—A continuation of his serial on instruments and measurements; the measurement of polyphase currents is also discussed.

Highly Sensitive Electrometer. Dolezalek. *Zeit. f. Elektrochemie*, abstracted from the *Zeit. f. Instrumentenkunde*, p. 65.—A description of two forms of the instrument suggested by him and Nernst, in which a dry pile is connected with the needle of the quadrant electrometer. Owing to the great sensitiveness of the instrument, it can be used in a large number of accurate measurements; one important advantage is that it is independent of magnetic fields; for 0.01 volt one of these instruments gave a deflection of 100 to 200 divisions; they are easily transported; they may be used as differential instruments.

Standard Thermic Voltmeter of Mercury. Camichel. *L'Elec.*, July 31.—A reprint of an Academy note. The current is passed through a portion of a column of mercury in a glass tube, the upper part of which has a smaller diameter; the expansion of the mercury produced by the heat is used to measure the voltage; the diameter should not be too small, it being better to make the tube very long, as one meter, for instance.

Thermic Mercury Amperemeter. Camichel. *L'Elec.*, July 24.—A reprint of an Academy note describing a new system devised by him. It consists of a mercury thermometer, the bulb of which is placed in a slightly larger glass tube, the vacant space between the two being filled with mercury; the current to be measured is passed through this mercury for 30 seconds and the rise in temperature is read from the thermometer. The data for an instrument for measuring up to 20 amperes is given; the mercury resistance is 0.2 ohms and the maximum temperature 30 degrees; the calibration curves are very regular; the surrounding temperature has no appreciable influence; it may be used equally well for alternating currents.

Researches with the Bois Magnetic Balance.—Zeit. fuer Elek., July 15; abstracted from the *Zeit. f. Instrumentenkunde*, 353, 1896.—The results of researches made at the Reichsanstalt; the article appears to be the same as the one referred to some time ago.

Electric Telethermometer. Meyer. *Elek. Anz.*, Aug. 5 and 8.—An illus-

rated description of various systems for measuring temperature from a distance; it appears to contain nothing new.

Instruments for Determining Frequencies. MOLER and BEDELL. *Elec. Eng.*, Aug. 19.—A very brief abstract of a recent paper describing two instruments; one of these has already been described in these columns; the second consists of a wire stretched over a sounding board, the wire carrying the current and passing between the poles of a magnet; by means of a sliding bridge the period of the wire may be made equal to that of the current, and the frequency is obtained directly from the scale reading.

Tesla Coil. WOODS. *Elec. Rev.*, Aug. 18.—A brief illustrated description of the construction of a small high-frequency transformer of the Tesla type, giving the results of the author's experiments during the past two years; the transformer is intended to be operated by ordinary induction coils from one with a 3-inch spark upwards; the primary winding is on the outside and the secondary on a removable spool on the inside; the ratio is one to ten.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Submarine Telegraphy. ROSSEL. *L'Eclairage Elec.*, July 24.—The first part of an article which seems to be chiefly devoted to the recording instruments.

The Relay and Its Relations to the Telegraphic Circuit. LOCKWOOD. *Elec. Rev.*, Aug. 4, 11 and 18.—The conclusion of the reprint of his very long paper; he summarizes his opinions and convictions in 17 concluding paragraphs, the subject matter of which is briefly as follows: Ampere-turns are what must be relied upon to secure magnetizing power and there should be a liberal allowance of them; a sufficiency will not be obtained by reducing the resistance by a series low resistance winding, as there is more lost in the magnetic strength than gained in the main current; resistance of itself has no special significance, but a specific resistance is a measure of a given winding because the resistance is proportional to the length of the wire; it is bad practice to connect a large number of relays in a single circuit; also to attempt to relieve such a circuit by connecting with it relays of low resistance made by using coarser wire; the standard 150-ohm relay is a good average for an average circuit; it is very bad practice to have high resistance and low resistance relays in the same circuit; they should all be uniform; a long winding in circuit with short ones will work well, but at the expense of the others; when a number of lines are run from the same battery they should all have the same resistance even if those of lower resistance must have artificial resistance added; that a line having multiple connections works well is no proof that a similar line with like low-resistance relays in series will also work well; a so-called law specifying the relative proportions of line and relay resistance has little force in practice other than indicating the impropriety of loading a single line with too many stations and relays; to change the relays of a line with many stations, joining the spools in parallel, reduces the ampere-turns of each relay 50 per cent.; such a change also increases the counter E. M. F. and magnetic inertia of each relay, the time constant being thereby reduced and the operation of the circuit improved; it is therefore conceivable in a line with many relays, that the advantages of parallel connections may outweigh the disadvantages; if therefore a line is overloaded with relays the relief by transferring a portion to other lines is inadmissable, the plan of connecting in multiple being most feasible and will be attended with good results; to shunt the spools with a resistance is well spoken of, especially if a switch is placed in the shunt so that it can be opened when a message is being received; to place a portion of the battery at a way station would generally be an advantage; the introduction of polar relays and operation by reversals under present conditions is not desirable.

Thermo Piles for Telegraph Purposes. ATHEARN. *Teleg. Age*, August 16.—In a short article entitled "Electricity Direct From Heat," he states that a new thermo-electric generator has just been put on the market, which furnishes small amounts of current much cheaper than is possible in any form of chemical batteries or even with very small dynamos. Instead of using two pure metals, the inventor discovered two alloys that have the same melting point and the same rate of expansion under the action of heat; the alloys are both poured into different parts of a mould at the same time, whereby they are run together and solidify, thus avoiding a soldered joint; practically the same effects are produced as if the pure metals had been soldered together and heated; the upper ends are enclosed in a watertight compartment through which a stream of water is kept flowing; one generator can be used to charge two storage batteries at a two-ampere rate and these will work about thirty local sounders; there are conditions in which these thermo generators would be economical, while under other circumstances they should not be used; an estimate of the cost of operation is given.

MISCELLANEOUS.

Sterilization by the High-Tension Current. ANDREOLI. *L'Elec.*, July 31.—An article in which, after giving a brief history of what has been done, he describes some experiments made by him. He used high-frequency currents and succeeded in some cases while in others he did not; he used a transformer of 10,000 volts; one of the plates was placed in the water and the other, which was provided with points, was suspended above the surface of the water; floating bodies on the surface moved rapidly while the discharge passed and tended to go to the metallic plate or the sides of the vessel and then stop; he also used a Tesla apparatus of about 70,000 volts; the idea was to create enormous tension in the water, which it was thought would destroy the organisms without electrolytically decomposing the liquid; the results were neither a failure nor a success; an examination of the liquid showed that sterilization had begun; the current of water should be very shallow and flow very slowly, being under the electric action for a long time. In some tests made by others it appears that the discharge precipitated the microbes of the air into the liquid, as they were more numerous after the experiment than before. He has abandoned the experiments, as he thinks there is more chance for success with sterilization by ozone, the chief problem being merely the efficiency of the generation of ozone.

Painlessness of Electric Death. HEDLEY. Lond. *Elec. Rev.*, Aug. 13.—After criticising very severely and ridiculing a recent article by Tyler in the New York *World*, he discusses the subject, suggesting that as far as loss of sensation is concerned, the condition most nearly analogous is that state in which a person passes who has received a severe blow on the head; in the case of electrocution it is reasonable to suppose that a true *commotio cerebri* is produced, amounting to actual molecular disintegration, which paralyzes and destroys the function of the cerebro cells; he concludes that it is probable that electrocution is painless and suggests the following sequence of events: "Entering the skull, a current diffuses itself through the brain, sweeping away the faculties of sensation, intellect and will; concentrating itself, it makes for the foramen magnum, smiting in its path that vast collection of conducting fibres and nerve centres—the medulla oblongata. The delicate mechanism by which vital functions (respiratory, vaso motor, cardio-inhibitory, etc.), are governed is thus destroyed, and it is on the balanced relationship of such functions that the thread of life depends."

Physiological Action of Currents. DUBOIS. *L'Elairage Elec.*, July 24.—A reprint of the article, an abstract of which was noticed in the *Digest*, last week.

Electric Furnace.—Zeit. f. Elektrochemie, Aug. 5.—An illustrated description of the Lelievre and Pictet forms, the principle of the latter being that the materials are first heated to a white heat by means of a cheap source of heat, the arc being used only to provide the necessary increase of temperature; it consumes but little more than the theoretical amount of electrical energy; owing to the very gradual increase of heat the product is very pure and uniform; the calculated cost of production of a ton of the carbide in this furnace is given as $16.40, of which $2.40 is for the current.

Operating Railroad Switches and Signals.—Zeit. fuer Elek., Aug. 1.—An illustrated description of the Siemens and Halske system, in which the switches are moved by means of electric energy.

St. Elmo Fires on the Seas. HALTERMANN. *Zeit. fuer Elek.*, July 15.—An abstract of a paper giving the results of systematic accounts kept in 1884–5, on German vessels, concerning this phenomenon; during the 77,300 days covering the periods of observations and number of ships 164 cases were noticed; deductions from these records are given.

Book Review.

JOHNSTON'S ELECTRICAL AND STREET-RAILWAY DIRECTORY FOR 1897. Containing Lists of Electric Light Central Stations, Isolated Plants, Mining Plants, Street Railways (electric, horse and cable), Telegraph Companies, District Messenger Companies, Telephone Companies, Manufacturers and Dealers in Electrical and Street-Railway Apparatus, Machinery and Supplies. New York: The W. J. Johnston Company. 752 pages. Cloth. Price, $5.00.

The aim of this Directory is to furnish reliable information relating to electrical, street-railway and kindred interests, so arranged and classified as to be of the most practical advantage to those interested. Apart from the convenient classification and arrangement of its contents, it gives, among other things, the names of managing officers, superintendents, electricians, purchasing agents, etc., of the different electric-light, street-railway and other companies; capital paid in; system in use, etc.; number of lights operated by electric-light companies, and whether or not these furnish electric power; prices paid for city lights by a large number of cities and towns; length of each street railway; number of cars operated, and equipment in use.

This work has been brought up to date in all respects, and all connected with electrical interests will recognize the importance and value of such a Directory. It has the further advantage of being the only one of its kind in America. The scope of the Directory is not confined to the United States but includes Canada, Mexico and Cuba.

Iron Trolley Poles.

In a recent circular issued by the National Tube Works Company much valuable information is given concerning iron trolley poles, which may be of interest to many of the readers of The Electrical World. The use of wooden poles for pole-line construction is open to many objections, mainly on account of rot, which attacks not only the butts and tops but also those places where nails or bolts have been driven in, permitting the entrance of moisture. The average life of a wooden pole of the first quality is in the neighborhood of eleven years, although, owing to local climatic conditions, this may vary considerably. The use of iron poles is strongly advocated, not only on account of their durability, but also on account of rigidity and stability, since upon these factors are dependent the whole

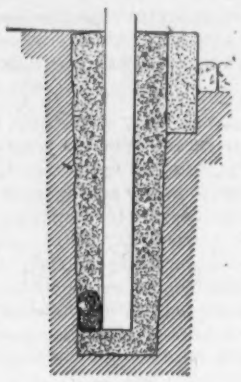


Fig. 1.

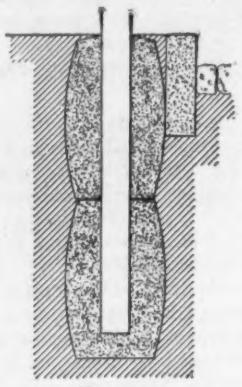


Fig. 2.

overhead construction and trolley alignment. If the poles are thoroughly painted once in six years, with a good anti-rust paint, no depreciation can be discovered at the end of 12 years, and it is fair to assume a life of 33 years. Iron poles are often made up of sections of pipe of varying diameter, and the method of mechanically connecting the different sections is by heating the larger pipe, and while hot, swaging it over the smaller cold pipe to a depth of about four times its diameter. When the joints are cool the shrinkage of the outer pipe grips the inner one so securely that the union is stronger than either single pipe.

In straight lines the strains to which the poles are subjected are compression due to the weight of the conductors and additional compression due to the accumulation of sleet and ice. Wherever the lines are dead ended, a strain is experienced due to the contraction of the conductors in cold weather, and under such conditions the poles should be firmly head guyed. The maximum side strain due to wind pressure is about 30 pounds per square foot, and in the case of a pole 40 feet high, 7 inches in diameter at the top and 14 inches in diameter at the bottom, the pressure would be equivalent to 500 pounds at the bottom, which increases rapidly for higher poles, amounting to 100 pounds additional for the next 5 feet. Four No. O B. & S. insulated wires will add approximately 400 pounds to the horizontal effort to be resisted by the pole foundation with a 100-foot span.

Since the buried surface of the pole does not afford a sufficient bearing against the surrounding soil, additional measures have to be employed in

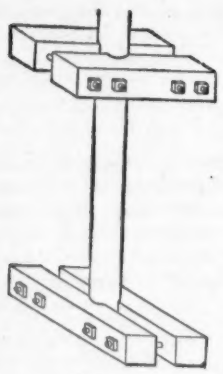


Fig. 3.

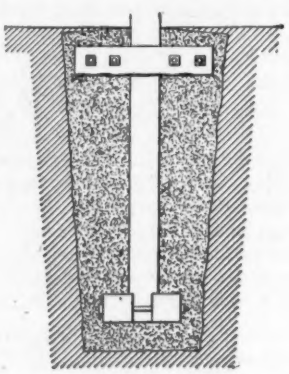


Fig. 4.

preparing the foundation. The depth of the hole is governed entirely by the character of the soil, but under ordinary conditions the depth for a 28-foot pole is usually from 6 to 7 feet. Fig. 1 shows the standard setting, in which the pole is surrounded by concrete. An excellent concrete is made by thoroughly mixing one part of Portland cement, two parts of sharp sand and four parts of broken rock, the size of hickory nuts, with enough water so that it will rise to the top of the mixture if allowed to settle. Before setting the pole, from 6 to 8 inches of concrete should be put in the hole and thoroughly tamped, taking great care that no dirt shall fall into the concrete. In clay soil or clay and small stone mixed, the hole may be from 18 inches to 2 feet in diameter, and in any case should be dug from 6 to 8 inches deeper than the pole is to be set, with fairly smooth sides, in order that dirt may not be knocked down and mixed with the concrete in the process of tamping. About four cement barrels full of concrete will be required for a 6 inch pole set in a hole 20 inches in diameter and 6 feet deep. In loose, sandy ground, where it is impossible to dig to the proper depth without caving in, barrels set on end, as shown in Fig. 2, are employed. It may be interesting to mention in this connection that a similar plan has been adopted by the American Telephone & Telegraph Company in building its magnificent telephone lines. When the first New York-Chicago line was built, great trouble was experienced in the region from South Bend to Laporte, Ind., on account of marshy and sandy soil. In this case small rocks were used instead of concrete and the plan was found to work admirably. Where the earth is very loose and wet, special provisions have to be made around the base of the pole, as shown in Figs. 3, 4 and 5, in order to furnish additional bearing surface. If solid stone is met with in small quantities, but

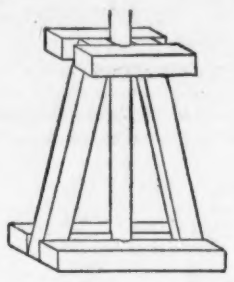


Fig. 5.

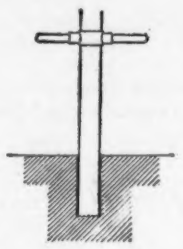


Fig. 6.

not of sufficient amount to warrant the use of a steam drill, a simple boring device may be improvised from a piece of iron pipe the size of the pole, having teeth filed on one end, as shown in Fig. 6. By rotating the drill and feeding it with No. 0 emery and water, a hole to the depth of 3 1-2 or 4 feet may be bored in a few hours, and the core then broken out by means of a chisel.

230-Volt Plant in the Sterling Building, N. Y. City.

Isolated plants with 230-volt two-wire systems are being adopted now in places where the saving of copper is not the incentive to the use of high pressure. Such a plant has been put in the Sterling Building, on Seventeenth street, New York City. Here there is a considerable motor load, and the plant, being small, it is desirable to operate it on one dynamo and provide for emergencies by a "break-down" service from the Edison three-wire public system. The most simple method of accomplishing these results is obviously to install a straight 230-volt outfit. The plant consists of a direct-connected American Ball engine and 75-kw six-pole dynamo, running at a speed of 290 revolutions. Steam is supplied by an Abendroth & Root boiler, fed through an Excelsior feed-water heater. Five hundred 110-volt lamps are connected, worked two in series. Several enclosed arcs are run in the same way. Stationary motors of about 30-kw aggregate capacity are used, besides one Sprague passenger elevator of the drum type.

A New Type of Plastic Bonds.

A new bond embodying the Edison-Brown plastic-contact principle has been put on the market by Mr. Harold P. Brown, of New York City. It is called the welded flexible bond, and, as shown in the illustration, is made of a number of clip-shaped strips of sheet copper. These sheets are welded

A New Rail Bond.

together at the ends, and in each end is welded a copper stud which is covered with the plastic amalgam. The studs are inserted in holes in the rail ends and fastened by being upset. These bonds have been adopted by the Metropolitan Traction Company, of New York; and the New York, New Haven & Hartford Railroad Company. The value of the plastic alloy used in these bonds is becoming more and more appreciated as time develops its staying powers. It has been aptly called "metallic grease." It serves the double purpose of preventing oxidation and making a tight metallic contact. The specific resistance of the amalgam is said to be less than that of copper. The standard plastic bonds have been adopted for the new Central London Underground Railway.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, August 23, 1897

ELECTRICAL STOCKS.—Weakness characterized the market for these securities at the close of last week. General Electric, which was traded in to the extent of 9940 shares, shows a slight decline of ½ point. This stock closed at 36¼, having previously been down to 35⅝. The movement of other electrical stocks was slight. Edison Electric Illuminating of New York fell off from 125¾ to 125, while the Brooklyn Edison Company shows a slight gain.

TELEGRAPH AND TELEPHONE.—There were slight evidences of decline and weakness in these stocks during the past week. Commercial Cable fell off 1 point, while Western Union sacrificed some of the gain of last week, having receded ½ point. There was considerable activity shown in this stock, the sales during the week amounting to 28,545 shares. Its range during the week was from 90¾, the lowest point, to 93, closing at 91⅞.

ELECTRICAL STOCKS

	Par.	Bid.	Asked.
Chicago Edison Company	100	121	..
Edison Electric Ill., New York	100	123	125
Edison Electric Ill., Brooklyn	100	115	117
Edison Electric Ill., Boston	100	147	148
Edison Electric Ill , Philadelphia	100	..	
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	27¼	27¾
Electric Storage, pref	100	30½	31½
General Electric	100	36⅜	36½
General Electric, pref.	100	80	82
Westinghouse Consolidated, com	50	21	23
Westinghouse Consolidated, pref.	50	55	57
BONDS			
Edison Electric Ill , New York, con. 5s	105	112⅞	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb 5s	100	100	..
TELEGRAPH AND TELEPHONE			
American Bell Telephone	100	236	238
American District Telegraph	100	..	27
American Telegraph and Cable	100	92½	95
Central and South American Telegraph	100	124	127
Commercial Cables	100	170	
Erie Telephone	100	66¼	66½
New England Telephone	100	104½	105½
Postal Telegraph Cable	100	99	101
Western Union Telegraph	100	91⅞	92
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	18⅛	18⅜
Brooklyn Rapid Transit	..	33	34
Brooklyn Traction	100	..	14
Brooklyn Traction pref	100	46	48
Buffalo Street Railway	100	76	78
Cleveland Electric Railway	100	..	..
Columbus Street Railway	100	40	43
Hestonville	100	49⅞	50
Hestonville, pref	..	..	62½
New Orleans Traction	100	6	8
New Orleans Traction, pref	100	25	28
North Shore Traction	100	20	22
North Shore Traction, pref	100	82	84
Rochester Street Railway	..	13	15
Steinway Railway	..	45	50
Union Railway (Huckleberry)	..	100	110
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	93¼	93¾
West End, Boston, pref	100	100	100½
Worcester Traction	100	16	18
Worcester Traction, pref.	100	90	93
BONDS			
Brooklyn Rapid Transit 5s, 1945	100	88	..
*Buffalo Street Railway 1st con. 5s	100	109	111
Cleveland Electric Railway 1st mtge., 5s	100	102	104
*Columbus Street Railway 1st 5s	100	94	97
Rochester Street Railway 1st 5s	100	..	85
Union Railway (Huckleberry) 1st mtge. 5s	..	106	108
*Westchester Electric 1st mtge. 5s	100	100	103

*With accrued interest

ELECTRIC TRACTIONS.—The majority of the stocks of this list slightly advanced during the past week. Union Railway gained 2 points, closing at par, while Columbus Street Railway advanced 3 points from 37 to 40. Brooklyn Rapid Transit on small sales showed a gain of 2 points.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, August 26, 1897.

ENOS M. BARTON, president of the Western Electric Company of Chicago, is on a visit to this city. He is at the Albemarle Hotel.

THE CUTLER-HAMMER MANUFACTURING COMPANY, of Chicago, has placed the Eastern agency of its motor-starting rheostats, speed regulators, field regulators, and so forth, in the hands of the Holtzer-Cabot Company, 112 Liberty Street, New York City.

A COMPLETE TELEPHONE SYSTEM is being installed for the Davis Coal & Coke Company, at its mines around Piedmont, W. Va., by Laemmel & Bruckner, 136 Liberty Street, New York City. The contract calls for thirty-four instruments and seventy-two miles of pole lines.

MR. E. KUHLMAN, president of the Kuhlman Electric Company, Elkhart, Ind., passed through New York City Thursday on his way West. This company have recently placed upon the market an improved transformer, which, Mr. Kuhlman informs us, is meeting with great favor.

ELECTRIC RAILWAY EXTENSION.—The Staten Island Electric Railroad Company has just begun the operation of a new line from Port Richmond to Bull's Head. The new branch is about 3 miles long, and has been built in just ten days. The last rail was laid at 9 o'clock on the evening of August 21, and shortly afterward the completion of the line was celebrated.

THE A. L. BOGART COMPANY has purchased from the estate of Mr. E. E. Bogart, deceased, the stock and good will of the electric gas lighting and electrical supply business that had been carried on by him in this city under the trading name of A. L. Bogart. The address after September 1st will be changed from 22 Union Square to 50 East Twentieth Street. Mr. A. Livingston Bogart, son of the founder of the business, the late Mr. Abraham Bogart, is president and general manager of the new company. Mr. Bogart's many friends will join THE ELECTRICAL WORLD in wishing him and the business continued success.

APPLICATION GRANTED.—The State Board of Railroad Commissioners at Albany has granted the application of the Second Avenue Railroad Company, of New York city, for permission to change its motive power to the underground electric system. The board has also granted the application of the Forty-second Street, Manhattanville & St. Nicholas Avenue Railroad Company, of New York city, to substitute the underground trolley system for its present motive power. The latter asked to be allowed to adopt either electricity or compressed air in the operation of its line, but the board stated that it did not desire at this time to pass upon the merits of compressed air as a motive power.

"RINGING UP" COAL.—Conductors and cashiers are not the only people who have their doings made straight by means of the cash register. In one place at least, in New York City, an enterprising firm of bootblacks use the regular street-car register for recording the number of "shines" given during the day. But it remains for the Coney Island & Brooklyn Railway to apply the fare register to the weighing of coal in their power house at Smith and Ninth Streets. There is no apparatus for automatically weighing coal in that power station, so a platform scale is provided, and placed just beneath the overhead chute from which the wheelbarrows are filled. The scale is adjusted to tip the beam when 300 pounds of coal have been placed in the barrow. While the coal is running out of the chute into the barrow, the attendant is required to yank the register cord, and ring up one barrow of coal. The firemen are held rigidly accountable for the quantity of coal burned per day, and any excess, when compared with the number of cars run and passengers carried, is very forcibly placed before them—so much so, in fact, that the weighing is productive of very close firing and careful management of the boilers. The scheme is an admirable one, and with one or two improvements could be adopted very widely. The first improvement would be to provide some sort of locking device attached to the scale, so that the chute could not be opened when the barrow was not in position to receive the coal. Second, the locking device to hold the barrow securely if more than 300 pounds were put in at one time, the same device to shut and lock the chute when 300 pounds had run into the barrow. Third, the barrow only to be released by the locking device when it is properly filled as above, and then only by the ringing up of the load, on the register placed for that purpose. It would not be costly to do as above, and the mechanism of one of the automatic bicycle holders would do the locking and most of the other things.

New England Notes.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., August 23, 1897.

AMERICAN ELECTRICAL WORKS ANNUAL CLAM-BAKE.—President Eugene F. Phillips never looked more contented, radiant and happy than on last Saturday, August 21, in welcoming in the morning, at the Narragansett Hotel, Providence, the early contingent to his nineteenth annual clambake, and also subsequently at the Pomham Club in receiving later arrivals and everybody. He was as of old and always, the embodiment of the modest, courteous and affable gentleman. The rays of sunshine which have never deserted him upon the occasions of his annual gatherings, were strong and brilliant, and the cooling breezes from the beautiful Providence River and Narragansett Bay were never more refreshing. It was in fact a great and perfect day for everybody, and everybody appreciated it. The Pomham Club and grounds never appeared more inviting. Everything, in fact augured the fullest enjoyment and pleasure, and which was most thoroughly experienced from the early dawn of the eventful day to its close. It would be but repetition to recount the entertainment of the day, as it did not materially differ from others that have preceded it. The guests were conveyed to the grounds by specially chartered electric cars. Upon reaching the grounds each guest was invited to register his name, after which he was clothed with the usual satin badge, and presented also with an outing cap, appreciated thoughtfulness on the part of mine host Phillips, particularly by those whose head-covering had on many occasions been attacked or demolished amid the fun and sports, which, by the way, included, as always, baseball, football, bowling, billiards, shooting, quoits, etc. The punchbowl was of course in evidence, and was as good as ever, enlivening the spirits and whetting the appetite for the magnificent luncheon served at 11:30. Immediately preceding the bake the customary group photograph of the entire company, which is herewith reproduced, was taken. At 2 o'clock the gong was sounded for the bake and dinner, which, it goes without saying, was the Pomham Club's "best," and which fully occupied everyone for over an hour, each guest while seated at the table being presented with the usual souvenir, which this year was a handsome silver-headed cane, appropriately inscribed in honor of the event. The dinner over, President Phillips rapped for order, and in a neat and graceful speech presented as toastmaster Mr. Samuel L. Powers, of Boston. Mr. Powers responded gracefully to the introduction, alluding most fittingly and eloquently to the occasion. Among the speakers introduced by Mr. Powers were Mayor Edwin D. McGuinness, of Providence, who spoke words of welcome; Mr. Geo. R. Stetson, of New Bedford, second vice-president of the National Electric Light Association, who responded for the "Electric Lighting" interests; Mr. Samuel A. Duncan, of the Postal Telegraph Company, who answered to the toast, "The Telegraph," in a most humorous vein; Col. H. F. Woods, of the West End Street Railway, Boston, who expatiated upon the "Electric Railway;" Mr. Robert F. Ross, who responded to the toast of the "Electrical Press," and Col. John C. Wyman, Rhode Island's orator, who made one of his characteristically happy speeches. During the speeches the convivial quartette did not fail to assert itself, the entire party joining in the chorus:

One, two, three, four, five, six, seven,
All good electricians go to heaven;
When they get there they all will screech
Eugene Phillips he's a peach.
Ta-ra-ra-boom-de ay, etc.

At the conclusion all arose and gave three cheers and a tiger for President Phillips, the banqueting hall resounding with the vigorous thumps of the souvenirs canes upon the floor, to which Mr. Phillips modestly responded, "Come Again." The following were in attendance: New York—J. H. Graham, Joseph Gardam, J. T. Hatzel, D. Chalmers, B. E. Greene, G. S. New, S. S. New, W. H. Taylor, Jefferson Wetzler, E. F. Peck, Elmer P. Morris, Stephen L. Coles, P. C. Ackerman, Jos. Keefe, F. A. Wunder, M. A. Shaw and Stephen Goddard. Boston—Frank Ridlon, Jno. S. Keenan, H. F. Cottle, E. B. Hatch, P. S. Ryan, Chas. H. Patch, J. S. Butler, Phillip M. Reynolds, D. W. Dunn, W. M. Deming, J. S. Wells, A. D. Blodgett, Geo. R. Blodgett, C. M. Ransom, D. J. Cartwright, H. N. Ballard, S. A. Leedom, Wm. Leyburn, F. S. Price, C. N. Goward, W. L. Coleman, Jas. L. Kimball, Fred. Preston, Geo. W. McBride, H. P. Moore, C. S. Matthews, D. M. Bliss, F. W. Ness, A. Pollard, C. F. Baker, J. L. Mitchell, Wm. J. Murdock, C. W. Holtzer Wm. Anderson, H. C. Spaulding, F. P. Costello, C. F. W. Schlinger, Henry F. Woods, C. Q. Ring, Howard F. Grant, H. G. Martin, Samuel L. Powers, W. H. Lane, Stephen D. Crane, H. J. Pettingell, Anthony McCabe, P. Fahey, W. O. Turner, Jas. Casey, Sears B. Condit, F. S. Palmer, R. F. Ross, Capt. Wm. Brophy, P. L. Warner, L. P. Webber, A. A. Ziegler, Chas. B. Price, T. J. Brown, Wetherbee & Whitney and Chas. B. Burleigh. Providence, R. I.—Robert Fessenden, E. T. Ames, A. L. Capper, Jno. I. Drake, W. C. Ingersom, M. A. Chase, F. C. Holst, C. McMurray, C. S. Campbell, R. H. Whittier, E. R. Phillips, F. N. Phillips, Eugene F. Phillips, W. H. Sawyer, Wm. H. Sweet, Jas. H. Palmer, Walter Thurber, D. D. Harris, H. M. Barry, N. T. Agers 2d, Wm. C. Woodward, L. W. Downs, F. H. Rickhausen, H. J. Jarge, E. Fales, Henry V. A. Joslin, W. W. Demster, M. P. Gannett, Jr., Fred. A. Hill, Orland Freeborn, J. M. Addeman, F. C. Hutchings, Chas. F. Luthen, A. T. Potter, W. N. Munro, Samuel B. Allen, Howard Greene, J. H. Tucker, N. M. Russell, V. A. Thomas, Jno. O. Darling, J. P. Olney, J. S. Murdock, J. H. Baker, J. R. Dickerson, W. D. Wright, J. E. Budrew, Irving F. Patt, D. F. Hayden, C. R. Remington, Jr., C. H. Wegenseil, Gardiner C. Sims, Chas. W. Russell, Henry O. Earle, Edwin D. McGuinness, A. C. White, Wm. L. Adams, W. J. Barnes, Wm. A. Tirney, Arthur E. Sisle, J. A. Vickery, J. B. Smith, G. A. Wall, O. B. Hawxhurst, E. C. Law, H. S. Tamner, A. C. Denton, H. L. Manchester. Miscellaneous—E. E. Tremaine, V. K. Carpenter, J. H. Sherman, Geo. W. Smith, B. F. Simmons, B. E. Waters, J. F. Conway, H. L. Marsden, Brockton; F. G. Hills, John Grossman, A. W. Hayden, Waltham, Mass.; Osborne E. Pettman, E A. Chappell, G. J. Corbin, C. M. Coburn, Chelsea, Mass.; J. P. Coghlin, E. W. Ham, F. O. Plummer, E. W. Howard, E. L. Pierce, Henry D. Tuttle, H. D. Temple, Worcester, Mass.; L. R. Wallis, Geo. A. Blaisdell, Woburn, Mass.; Jno. A. Welch, Orin Smith, Geo. A. Capper, J. F. Campbell, M. C. Happolbet, W. C. Fales, Jno, W. Welmouth, Ed Duffy, F. J. Duffy, Pawtucket, R. I.; H. A. Philbrook, Jas. Holt, Watertown, Mass.; Samuel Young, L. A. Derby, E. S. Hosmer, Lowell, Mass.; J. F. Al-

Guests of the American Electrical Works at the Nineteenth Annual Clam bake.

bro, A. E. Burland, J. H. Scannevin, Newport R. I.; S. I. Fletcher, F W. Austin, Jno. McKnight, W. G. A. Potter, Quincy, Mass.; Duncan Kennedy, E. H. Bailard, Salem, Mass.; T. H. Burrows, Chas. A. Raymond, Portland, Me.; G. D. Brokaw, A. Morrill, Salem, Mass.; F. P. Drake, Canton, Mass.; E. T. Peck, Brooklyn N. Y.; C. B Russell, E. H. Bradford, Marlboro, Mass.; Jas McGraw, Richmond, Va.; Robert C. Brack, Wm. S. Prophett, Bridgewater, Mass.; J. B. Murphy, E. J. Brooks, Rumford, Vt.; J. T. Hedge, Jr., Jno. McHugh, Phillipsdale, R. I.; Chas. Sylvester, J. L. Patter, Chas. E. Earle, Fall River, Mass.; J. L. R. Davis, Albany, N. Y.; Ralph T. Smith, Westboro, Mass.; C . S. Bradley, C. S. Jones, New Britain, Conn.; R. W. Ransom, F. E. Donohoe, J. M. Atkinson, Chicago, Ill.; L. Bentley, New London, Conn.; W. L. Adams, Norwich, Conn.; Stephen B. Field, Stockbridge, Mass.; W. K. Wagner, Geo. R. Stetson, New Bedford, Mass.; A. L. Pierce, Franklin, Mass.; Fred. J. Lucey, John A. Appleyard, Natick, R. I.; Geo. L. Smith, Middleboro, Mass.; H. M. Young, L. M. Levine, Woonsocket, R I.; J. A. Whitcomb, Baltimore, Md.; L. D. Houghton, Valley Falls, R. I.; S. R. Peck, Barrington, R. I.; F. P. Hall, Philadelphia; W. H. Coleman, Leon F. Hawley, Andover, Mass.; A. G. Waldon, Blackstone, Mass.; S. A. Duncan, Pittsburgh, Pa.; Geo. R. Cook, Attleboro, Mass.; John C. Wyman, Central Falls, R. I.; F. B. Baker, E. B. Baker, New Haven, Conn.; A. O. Shepardson, L. W. Sweet, Waterbury, Conn.; F. L. Terry, New London, Conn.; L. B. Favor, J. A. Cameron, Gloucester, Mass.; Alpho Greene, Holly, Mich.; E. H. Farr, Thomsonville, Conn.; Harry Bottomley, Marlboro, Mass.; V. W. Porter, Derby; W. C. Greene, Concord, N. H.; E. M. Bryant, Manchester, N. H.; E. W. Bates, Cohasset, Mass.; Henry F. Kellogg, Wellesley, Mass.

THE O. C. WHITE COMPANY of Worcester, Mass., have on hand several large equipment orders for their adjustable electric fixtures for machine-shop and factory use. One of the more recent orders is from the Goodyear Shoe Machinery Company, of Boston, Mass., who will have some 500 of the "White" holders of large size in their new plant. These fixtures are certainly most convenient and efficient devices for the proper adjustment and control of the incandescent lamp, and their growing popularity is attested by the increased demand for them.

BUFFALO NOTES.

BUFFALO, N. Y., August 23, 1897.

BUFFALO AND NIAGARA POWER.—Buffalo is at present getting only 1000 horse-power from the Niagara tunnel. The rest of the 9000 horse-power is still furnished from the Buffalo power house. It is promised that no more will be furnished the street railway till other demands are met.

ANOTHER BUFFALO-NIAGARA FALLS LINE.—Tonawanda is about to give George P. Smith, who runs the trolley line in the Tonawanda towns and another to Buffalo city line, a permit to extend the line northward, with the idea of making it a second line from Buffalo to Niagara Falls. The project is opposed by the present, or Ely line, as it is called, but the application will be granted if there is not too much local opposition.

AN ELECTRIC GRAIN ELEVATOR.—It is announced that the Great Northern grain elevator, of 3,000,000 bushels capacity, will be ready for operating inside of a month. The company has a contract for electric power from the Niagara tunnel, but as neither the power nor the conduits will be ready the General Electric Company is putting in a three-phase 25-cycle alternator at the Elk Street railway power house, which is not now in use. Bad weather of late has delayed the work on the conduits.

AN ELECTRIC PUMP FOR THE WATER WORKS.—There is prospect of an electric pump for the water works. When the bids were put in for the new 30,000,000-gallon pump there was one from the Buffalo Enginering Works for an electric pump for $59,400, the Cataract Power & Conduit Company to furnish the electricity at $30 per horse-power annually. As the engine will be of 12,000 horse-power this means an annual expense of $360,000, just half the cost of operating a steam pump. The bid for the pump being the lowest, there is nothing to do but convince the Board of Public Works that the idea is feasible. The motor is to be furnished by the General Electric Company, the price appearing not to have been fixed.

PITTSBURG NOTES.

PITTSBURG, Pa., August 23, 1897.

TO CHANGE FROM STEAM TO ELECTRIC POWER.—The Wheeling & Elm Grove Railroad, which is now operated as a narrow-gauge steam road between Wheeling, W. Va., and Elm Grove, is preparing to adopt electricity as a motive power. An extension consisting of 3 miles of track is to be constructed within the city limits this fall, and next summer the entire road will be rebuilt and made into a trolley line. A baseball park on the line of the road is one of the improvements contemplated, and it is stated that the fare will be reduced from 25 cents for a round trip to 5 cents each way.

TRACTION COMPANIES AND FREE BRIDGES.—A contract has just been executed between the city of Pittsburg and the Pittsburg & Mount Washington Street Railway Company, by the terms of which the latter is to pay for the privilege of running its cars across the Smithfield Street bridge 7½ cents per car for each trip, and one-half cent additional for each car more than 30 feet in length. A similar contract existed between the Pittsburg & Birmingham Traction Company and the Monongahela Bridge Company, which formerly owned this bridge. After the city purchased the bridge and abolished toll charges on it, the Birmingham Company claimed the same privileges that were granted to the public, and refused to pay any more toll. The city holds that the contract is still valid, and if necessary will ask the courts to compel the Birmingham Company to pay toll as it did before the bridge changed ownership. In view of this situation, the voluntary execution by the Mount Washington Company of a contract to pay toll, is significant. The contract runs twenty years.

ST. LOUIS NOTES.

ST. LOUIS, Mo., August 21, 1897.

NEED NOT SIGN.—In the mandamus case brought by the North & South Railway Company against President E. F. W. Meier, of the City Council, to compel him to sign the bill conferring an extension franchise upon the company, the circuit judge denied the application for the writ. It is held that the president is answerable "only to his conscience and the people, who entrusted him with power.'

GRANTED AN EXTENSION.—The County Court last week granted an extension of six months to the Wellston, Creve, Coeur Lake & St. Charles Railroad Company, within which to begin work on its railroad from Wellston to St. Charles. The promoters of the enterprise represented to the court that they had decided to secure a private right of way and avoid the rock road, and more time was required to secure the right of way. The line is to parallel the St. Charles Rock Road from Wellston to St. Charles, crossing the Missouri River on a second bridge.

CITIZENS' COMPANY OBJECTS.—The Citizens' Electric Light & Power Company on August 9 notified the Board of Public Improvements that the class of material required by the board for the conduits under Broadway was unsuitable to that company. Last week the Board of Public Improvements adopted a report notifying the Citizens' Company that, in accordance with ordinance 18,680, the Board had been empowered to decide upon, prepare and approve such plans, details, construction, conduit ducts, manholes, materials and conditions as in their opinion the public interest seemed to demand.

SOUTHERN NOTES.

RICHMOND, Va , August 23, 1 97.

NEW TELEPHONE EXCHANGE.—For some time past Mr. L. D. Coltrane and others have been at work getting up a new telephone exchange for Concord, Va. The matter is now settled and the exchange is expected to be in operation by October 1. A number of subscribers have already been secured, all of whom have signed for five years' service. The name will be the Concord Telephone Company.

PROPOSED ELECTRIC RAILWAY.—Interest in the proposed electric railway from Staunton to Highland County is still alive and agitating the minds of the Staunton citizens. At the last meeting of the Chamber of Commerce arrangements were made to issue a call for a mass meeting of the citizens to consider the question. At an adjourned meeting of the City Council the matter of voting a subscription of $25,000 toward the road was brought up, but action was deferred until the next September meeting.

PACIFIC COAST NOTES.

SAN FRANCISCO, Cal., August 20, 1897.

A POWER TRANSMISSION PLANT FOR HAWAII.—The Westinghouse Electric & Manufacturing Company, through its Pacific Coast district agency, recently closed a contract for a 150-kw, two-phase alternating water-power plant, which will be driven by a 250-hp Pelton wheel, operating under a head of 715 feet. Included in the contract are a 75-hp and a 20-hp motor, both of the Tesla induction type. Step-down transformers, from 2000 volts, will be of the Westinghouse type. The plant will be shipped to Honolulu, Hawaiian Islands.

TELEGRAPH ENTERPRISE.—The Pacific Postal Telegraph Company is flourishing on the Coast under the enterprising management of Supt. L. W. Storror. During the late International Christian Endeavor Convention he established a free bureau of information at the company's main office in San Francisco, which was maintained for one month, and was highly appreciated by all classes of tourists. The Postal Company is now operating on the 3000 miles of wires along the lines of the Mexican railways, and will meet the Western Union's recent cut in business to points in Old Mexico.

A LARGE TRANSMISSION PLANT.—The Stanley Electric Manufacturing Company has secured the contract to install a three-phase electric-power transmission system for the Rawhide Mining Company, whose mines are near Jamestown, Tuolumne County, Cal. The generating plant will be located near Sonora, and will be operated by the water of the Tuolumne River, under a working head of about 500 feet. Included in the equipment are three special three-phase Stanley generators, all switchboard apparatus and transformers, for stepping up to 15,000 volts for transmission 15 miles, and down again to 2000 volts for the large induction motors; also to still lower voltage for the smaller motors. The Rawhide and the App mines will be operated and lighted by the new installation. Sidney W. Sprout acted as consulting engineer. The electric plant, which is now operating the Rawhide mine is not of sufficient capacity, it is said. The Tuolumne County Electric Power & Light Company sells electric power to the mining company at present.

ELECTRIC LIGHTING PLANTS FOR THE YUKON.—The California Electrical Works, San Francisco, recently sold to Capt. N. C. Rideout, who will establish a trading post in Dawson City, a 120-light Eddy generator, which he will use for commercial lighting. The General Electric Company recently sold a 4½-kw generator to the Alaska Commercial Company, which will be used to light a machine and repair shop in St. Michael. Joseph La Due, the fortunate owner of the Dawson town site, has expressed his intention of installing an electric central station. The first generator shipped from San Francisco to the Yukon mining region, was a Westinghouse alternator, which will supply a number of incandescent lights and a searchlight, to be used on a steam barge while ascending the river. The plant was ordered by Wm. D. Wood, president of the Seattle & Yukon Trading Company. His plan is to let the barge freeze fast in the ice, and illuminate the darkness of Dawson during the winter. Owing to the high latitude, no artificial light is needed in the summer.

Canadian Notes.

OTTAWA, Ont., August 23, 1897.

STREET RAILWAY EXTENSION AT LONDON.—It is proposed that the London Street Railway be extended beyond the Asylum of the Insane to Pottersburg, and also to connect the city with the town of Lucan.

READY FOR WORK.—Contracts for motors and generators for the proposed electric railway at Sherbrooke, Quebec, have been given to the Canadian General Electric Company; for closed cars to Messrs. Rhodes, Curry & Co., Amherst, N. S.; and for open cars to Messrs. Ahearn & Soper, Ottawa.

A CAUTIOUS COUNCIL.—At St. Thomas, Ont., negotiations are still going on between the City Council and the promoters of the proposed electric railway. The Council have decided to obtain a proper estimate of the cost of the railway before agreeing to give a guarantee as requested, to the bonds of the company, to the amount of $50,000.

A GENERAL SUPPLY COMPANY.—La Compagnie de St. Etienne de la Malbaie applies for a Quebec charter, with a capital stock of $5000; headquarters to be at St. Etienne de la Malbaie, to exercise the industry of electricity in all its branches. The incorporators are: J. Warren, H. Simard, P. Maltrais, A. Larouche, J. Conturier, and A. Guay, all of La Malbaie. The Alymer Electric & Manufacturing Company, Limited applies for an Ontario charter to provide heat, light and power by steam and electricity in Aylmer, Ont., capital, $20,000. The incorporators are: H. H. McDiarmid, D. C. Davis, J. Simpson, of Aylmer; J. N. Campbell, H. Irving, of Toronto.

English Notes.

(From Our Own Correspondent.)

LONDON, August 11, 1897.

THE BERMUDA-JAMAICA CABLE.—Just before it rose for its holidays the House of Commons was presented with a contract which has been entered into between the Government and the Halifax & Bermuda Cable Company for the construction, laying and maintenance of a submarine cable between Bermuda and Jamaica, via Turks Island. In the Treasury Minute accompanying the agreement, it is stated that the object of this new cable is the establishment of telegraphic communication between England and the West Indies, by a line under British control and landing only on British soil; urgent representations having been received by Her Majesty's Government as to the expediency on commercial as well as naval and military grounds of the establishment of a more direct telegraphic route to the West Indies than at present exists. It is specially stipulated that the shore ends of the cable are to be landed within a circle of the defenses of the fortresses. The cable is to be in working order within six months from the present date, and a continuous and satisfactory service at the rate of not less than fifteen words per minute is to be maintained. All Government messages are to be transmitted in priority to other messages at rates not exceeding one-half of those charged the general public, who are to be charged not more than 3 shillings per word. An annual subsidy, payable quarterly, of £8000 a year will be given to the company for twenty years. A three-months' interruption of service will not affect the subsidy, but a six months' interruption will result in half pay. Upon a failure to repair the cable, after six months' cessation of working, the Government will be at liberty to take possession of and work the concern, taking over all the receipts. There is a clause providing that the sum of £15,000 shall be exclusively appropriated and allotted to the cost of repairing the cable.

FREE WIRING.—Last week a concern called the National Electric Free Wiring Company came before the public with a request for a capital subscription amounting to £250,000. A point in the prospectus of this undertaking has aroused considerable controversy, and it bids fair to let considerable light into the actual cost of electric wiring. A firm of auditors who examined the books of the National Electric Free Wiring Company state that they found that the average cost of wiring each 16-cp lamp in the installations already carried out by this concern at Wallasey amounted to only 12s. 4d., and upon this basis the prospectus mongers have estimated a net profit of over £23,000 per annum. As practically the lowest figure for any wiring in this country which can by any stretching of the term be called "safe" amounts to quite £1, our leading wiring firms are up in arms, since if the figure of 12s. 4d. be correct it obviously follows that they must be reaping considerably more than the usual rate of trade profit. It is also obvious that the public, having had this figure of 12s. 4d. once drummed into their ears, are likely in future either to take all their wiring to the National Electric Free Wiring Company, or to insist upon it being done at a lower figure than heretofore. According to the letters appearing in the various financial and other papers from different wiring firms, it would appear that these can give no credence to the statement that the net cost of wiring per 16-cp lamp may be taken to average 12s. 4d. The secretary of the company has replied that the figure of 12s. 4d. is in reality by no means as low as it might have been placed, since the company has already, in the case of a large isolated installation in London, carried out the work at an average figure of 10s. per 16-cp lamp, and both in London and at Wallasey the wiring has been passed by experts. Of course, it is especially desirable in this country that the cost of wiring should be brought down to the lowest possible cost consistent with safety, but the skepticism of our wiring firms is shared by many who, although having a knowledge of the cost of wiring, are not actually engaged in the business. I may say that the title of the National Electric Free Wiring Company originates in the fact that it proposes to wire houses on the now popular method; that is to say, the consumers have their houses wired "for nothing" on the condition that they pay a certain additional sum per unit consumed, either forever after or for a certain period of years, as the case may be. There certainly should be room for profit in this direction, since in one or two cases which have come under my notice I have estimated that the wiring will cost the consumer in the end from two to three times as much as it would have cost him had he paid money down. On the other hand, the company putting in the wires runs considerable risk if the landlord does not make himself responsible in some way for the payments, but, surprising as the statement may seem, in many cases local "free wiring" companies have succeeded in making landlords back the contracts of their tenants.

INSTITUTION OF ELECTRICAL ENGINEERS NEW WIRING RULES.—The Institution of Electrical Engineers has issued a set of "general rules recommended for wiring for the supply of electrical energy," to take the place of the rules issued in 1888, which have now become out of date. The new rules differ in several important respects from the previous ones, and also from the regulations enforced by the various insurance companies. Among these innovations may be mentioned fairly detailed specifications of the cables and wires to be employed, including the electrical and mechanical tests, flexible cords being also subjected to electrical pressure tests. Cables insulated with material impervious to moisture must have a dielectric with a radial thickness of at least 30 mils more than one-tenth of the diameter of the conductor, and after twenty-four hours' immersion in water the insulation resistance of the cable shall not be less than from 300 to 1200 megohms per mile, according to the size of the conductor. Dielectrics not impervious to moisture are allowed if encased in a waterproof tube or envelope. In this case the cable has to be tested 2500 volts at a frequency of between 40 and 100 cycles per second for ten minutes, and the insulation resistance must not be less than 300 megohms per mile for all sizes of cables. The mechanical test consists in bending the test piece three times in one direction, and three times in the opposite direction round a smooth cylindrical surface not more than twelve times the diameter of the cable, measured outside the dielectric. The radial thickness of the insulation of flexible core conductors is not to be less than 16 mils for pressures up to 125, or 20 mils for pressures up to 250 volts. This material must withstand 1000 volts applied between the conductors for five minutes, the test pieces being "subjected during the test to the vapor arising from a pan of boiling water, at a distance not exceeding 3 feet, and immediately below it." Wood casing is allowed, but the draw-in system is recommended in preference to it. Interior conduits may be of any non-combustible material. Conductors spaced and separated away from the walls are not permitted unless they are mechanically protected throughout their entire length. Distribution from distributing boards in 5-ampere circuits is recommended, and it is also recommended that wires which must be buried within walls should not be fixed, but drawn into channels, such as porcelain tubes filled with sand. The insulation of installations is not to be less than 10 megohms, divided by the maximum number of amperes required for the lamps and for appliances. A second test is to be made fifteen days after the installation is set to work. A table is given showing the maximum current permissible in conductors of standard wire gauge. The maximum current allowed to pass through any conductor is calculated from the formulæ $C = 2.6\ I(A^{0.82})$, (A being the area in thousandths of a square inch), these currents working out at slightly less than those determined by Kennelly. For specially hot places the maximum currents must be less, the formula $C = 2\ A^{0.775}$ being given. It is evident that great care has been expended in the compilation of these rules, and it is to be hoped that the fire offices will unite in adopting them in preference to the different sets of regulations which they now enforce.

General News.

New Incorporations.

THE PENNY-IN-THE-SLOT ELECTRIC COMPANY, Chicago, Ill., has been formed with a capital stock of $250,000.

THE SIBLEY COUNTY TELEPHONE EXCHANGE, Gaylord, Minn., has been organized with a capital stock of $5000.

THE BAY CITY ELECTRIC LIGHT & POWER COMPANY, San Francisco, Cal., has been formed by William Cluff, A. H. Lissak, W. F. Harris and B. B. Duncan.

THE ELGIN CITY, CARPENTERSVILLE & AURORA RAILWAY COMPANY, Elgin, Ill., has been incorporated, with a capital stock of $500,000. The directors are William Grote, George P. Lord and D. B. Sherwood.

NORTHWESTERN TELEPHONE EXCHANGE COMPANY, St. Paul, Minn., has been formed with a capital stock of $3,000,000. The incorporators are R. M. Hankinson, John Watson, Leolin M. Towne, Frederick Hooker and Frank D. Jilson.

THE BROOKS-FOLLIS ELECTRIC CORPORATION, San Francisco, Cal., has been incorporated with a capital stock of $25,000. The incorporators are James H. Follis, Harrison Brooks, John W. Brooks, Richard N. Follis and E. A. McInerney.

THE AUTOMATIC ELECTRIC CLOCK COMPANY, Kansas City, Mo., has been incorporated with a capital stock of $50,000. The directors are A. E. Stillwell and T. H. Wickes. The object of the association is the manufacture and sale of electric clocks.

THE PENSACOLA ELECTRIC & TERMINAL COMPANY, Pensacola, Fla., has applied for a charter. The capital stock of the company is $200,000, and the officers are W. H. Northrup, president; A. C. Blount, Jr., vice-president; and Decourcey W. Thorn, secretary and treasurer.

SOUTHWESTERN MINNESOTA TELEPHONE COMPANY, Minneapolis, Minn., has been formed with headquarters at Pipestone, and the capital stock is $10,000. The incorporators are E. A. Cass, Oswald Cass, Mary M. Robinson, Louisa M. Cass, and Thomas F. Robinson.

THE STANDARD INCANDESCENT COMPANY, of New York City, N. Y., has been organized for the purpose of manufacturing and selling incandescent lamps, mantels and other articles. The directors are Harry E. Jennings, Samuel Bernheim and E. M. Saunders. Capital stock, $9000.

EMPIRE ELECTRICAL TRACTION COMPANY, New York City, N. Y., has been incorporated for the purpose of manufacturing electrical appliances. The incorporators are William W. Doty, James A. MacKnight, Charles C. Granten, Joseph C. Granten, Charles J. Beckermann and William Reinhart.

THE BARNES ELECTRIC LIGHT & POWER COMPANY, Maquoketa, Ia., has been organized with a capital stock of $40,000. The officers of the company are A. B. Bowen, president; Walter Doe, vice-president; Frank Barnes, secretary; Charles von Scrader, treasurer, and the Board of Directors includes C. W. Farr, Charles Gallagher, Dr. Avery, John Tubbs and Charles Goller.

THE TWIN CITY ELECTRIC COMPANY, Centralia, Ill., has filed articles of incorporation, with a capital stock of $15,000. The incorporators are John A. Gaynor, B. M. Vaughan, A. L. Fontaine, Charles Briere, George W. Davis, Brundage Brothers, D. D. Conway, Corriveau & Garrison, John E. Daly, George M. Hill, F. E. Kellner, J. W.Natwick,Will Gross, John Schnabel and W. D. Harvie.

THE TELEGRAPH AND TELEPHONE.

DENTON, TEX.—The Southwestern Telephone Company is extending its line from here to Whitesboro.

SUMTER, S. C.—F. C. Manning is contemplating the erection of a telephone exchange here with 100 'phones.

WARRENTON, TEX.—A telephone line is in course of construction between Carmine and this place and between Oldenburg and Fayetteville.

ABILENE, TEX.—The telephone line between this place and Anson, a distance of 28 miles, has been completed, and is said to be working very satisfactorily.

GADSDEN, ALA.—The construction of a telephone line from this place to Fort Payne has been begun. Stations will be established at Collinsville and other points in DeKalb County.

VERMILLION, S. DAK.—The telephone line from Sioux City to this place has become the property of the Northwestern Telephone Exchange Company, of Minneapolis, which will extend its line to Yankton and Centerville.

KNOXVILLE, TENN.—The People's telephone line has been completed and is in operation between Morristown and Knoxville, and connection with Bristol will be established as soon as the 7-mile line between Greeneville and Morristown is constructed.

ELECTRIC LIGHT AND POWER.

VALLEY FALLS, KAN.—An electric-light plant is to be established in this place.

VICKSBURG, MISS.—The Vicksburg Electric Light Company will improve its plant.

BALLARD, WASH.—The Council has authorized the purchase of an electric light plant.

GRAND MARAIS, MICH.—An electric light plant has been established at Grand Marais.

NORTH WALES, PA.—Excavations are being made for a new power house for the electric light plant here.

HENDERSON, MINN.—A special election was held here, and resulted in favor of issuing electric-light bonds.

BEDFORD, IA.—Mr. C. Wilbur Wiley will put in an electric light plant at this place. The plant will be of about 100-hp capacity.

HANNIBAL, MO.—The city has voted to issue $8000 in bonds to improve the electric light plant, so as to enable the city to furnish electric power.

TROY, N. Y.—The Hudson River Power Transmission Company has secured permission to string wires and erect poles through the town of Halfmoon.

DELPHOS, OHIO.—The committee appointed to inquire into the feasibility of putting in a municipal electric light plant have reported favorably.

ELMORE, OHIO.—The question of establishing a municipal electric-light plant in this place was defeated at a special election by a vote of 103 to 92.

TERRELL, TEX.—The ice and electric plant owned by C. Vanordstand was destroyed by fire recently, entailing a loss of about $15,000. Insurance, $12,500.

LONG ISLAND CITY, N. Y.—The Electric Illuminating & Power Company, of this place, has certified to an increase in its capital stock from $150,000 to $500,000.

McCOMB, OHIO.—Mr. Richey, of Bloomdale, has been granted an electric light franchise, and has purchased grounds for the plant, which will be erected as rapidly as possible.

GRAFTON, N. DAK.—The city of Grafton is in the market for a 50-kw alternator, complete, with exciter and switchboard instruments. Address D. A. Willard, city electrician.

BEVERLY, MASS.—The electric light company of this place is about to change its entire system to the Edison three-wire system. The cost of the change will be about $20,000.

BELOIT, WIS.—The Wiley and Warner electric light plant has been purchased by G. L. Cole, owner of the Beloit electric light plant, and M. H. Taylor. It is said the plants will be consolidated.

ROCKVILLE CENTRE, L. I.—The citizens of this place have decided to adopt electricity instead of gas for illuminating purposes, and it is probable that an electric lighting plant will be installed here this fall.

ROCHESTER, MICH.—The Common Council has granted to Ambro Bettis, of Newberry, Mich., a ten-year franchise to light the city with electricity. Mr. Bettis says the lights will be in operation in three months.

PETERSBURG, IND.—The plant of the Petersburg Electric Light Company was blown to pieces on August 19, causing a loss of $10,000. The cause of the explosion is not known. Fortunately no one was injured.

LANSINGBURGH, N. Y.—At a meeting of the directors it was decided to issue the balance of the capital stock $25,000, for the purpose of purchasing new boilers and dynamos, in order to increase the facilities of the plant.

NEW BRIGHTON, PA.—The Beaver River Power Company has commenced the erection of an electric light plant on a plot of ground recently purchased in Fallston. The company has applied for a charter, and will furnish electric light for the entire valley.

HURON, IA.—Harry C. Sterling has completed arrangements for re-establishing an electric light plant here. He has purchased the old plant and property of the Huron Electric Light & Power Company, and leased the Risdon artesian well, with which to furnish the power.

EAST GREENWICH, R. I.—The real and personal estate of the Phoenix Electric Light & Coal Company was sold at auction on August 17, by the Industrial Trust Company, under a trust mortgage deed. The property was purchased for $18,000 by a committee representing the bondholders.

CHICAGO, ILL.—Sealed proposals are invited by the Board of Directors of the Chicago Public Library for 10,000 Edison base incandescent lamps for the building of the Chicago Public Library. All bids must be addressed to W. B. Wickersham, at the office of the Chicago Public Library.

MERRILL, WIS.—Sealed proposals will be received up to September 7 next for lighting the streets and public grounds and buildings of the city of Merrill for a term of five years, according to schedule plans and specifications on file in the City Clerk's office. J. P. Anderson, City Clerk.

SCRANTON, PA.—The Suburban Electric Light Company has given notice that on September 1 the price of incandescent lights within the city limits will be reduced to five-eighths of a cent per lamp hour, subject to a discount of from 10 to 20 per cent. if the bill is paid on or before the 20th of the month in which it is presented.

RACINE, WIS.—The stockholders of the Belle City Electric Company held a meeting and elected directors, who in turn selected the following officers: President, Joseph Miller; vice-president, H. M. Wallis; secretary, Jackson I. Case; treasurer, Frank J. Miller. The directors were authorized to purchase the entire plant and belongings of the Belle City Electric Street Railway Company for $150,000.

SKOWHEGAN, ME.—The Skowhegan Light & Power Company has placed a contract for a new power house. The building will be erected on property on the Kennebec River, and will cost about $10,000. The contract provides for a brick building with steel roof and finish, 64 feet by 30 feet, two stories in height and an annex one story in height, 60 feet by 27 feet. The building is to be completed by October 1.

TACOMA, WASH.—The special Council committee appointed to investigate the conduct of the light plant has made its report to the Council. The committee found the plant in a very uneconomical condition. The engines and boilers and auxiliary apparatus were old fashioned and uneconomical. It will cost about $40,000 to reconstruct the plant, so that it can be economically operated. In the month of May the committee states electricity produced at the city plants cost 2.76 cents per kilowatt hour, or a total for the month of $1752. The same amount of electricity at the rate paid for this day load rate now purchased under contract would have cost the city $952. Or, in other words, if the city had purchased its electricity at the rate paid for the day load it would have saved in May $800. This would amount to a saving of $9600 a year.

THE ELECTRIC RAILWAY.

BRAINERD, MINN.—The Brainerd electric street-car line recently discontinued business here. The road is said to have ben a losing investment from the start.

TAMPA, FLA.—The Fort Brooke Council has granted to Col. F. A. Salomonson and associates a permit to build an electric line through the streets of that town.

FAR ROCKAWAY, L. I., N. Y.—A franchise has been granted to the Ocean Electric Railroad Company, of Far Rockaway. Work will be commenced at once.

MILFORD, DEL.—Arrangements have been made to have a trolley line connect with the D., M. & V. Railroad. The work on the road will commence at an early date.

NEW BRUNSWICK, N. J.—The New Brunswick Traction Company, of New Brunswick, has applied to the Perth Amboy Board of Aldermen for a franchise for an electric railway system.

NEWARK, N. J. The ordinance for the franchise of the South Orange & Maplewood Railway Company to cross Main Street at grade was finally passed, and has been signed by the mayor.

NEW BRUNSWICK, N. J.—The work of constructing the trolley line from New Brunswick to Bound Brook and Metuchen was begun on August 18. It is said the road will be in operation by October 1.

BALTIMORE, MD.—There is a movement on foot to extend the electric road of the Baltimore & Washington Transit Company, which is largely controlled by Baltimore capital, from Sligo Creek to Sandy Springs.

RALEIGH, N. C.—Morganton has taken preliminary steps toward building a 40-mile electric railway from that place to Blowing Rock. A committee of ten has been directed to make an immediate survey and procure a charter.

PHILADELPHIA, PA.—James W. Baird, a well-known business man of Philadelphia, who is largely interested in property here, has completed negotiations for the construction of a trolley line between here and Woodbury. The work of building will be commenced in the fall.

EAST LIVERPOOL, OHIO.—Messrs. M. & J. Head, of the East Liverpool & Fredericktown Electric Railway Company, will soon build a passenger and freight line to be operated by electricity from East Liverpool, connecting with the Erie and Baltimore & Ohio at Lisbon and Niles.

MONTICELLO, N. Y.—The Fallsburg & Monticello Railroad Company has been given permission to construct an electric road from the station of the New York, Ontario & Western Railroad at Fallsburg to the station of the Monticello, Port Jervis & New York Railroad at Fallsburg.

SAGINAW, MICH.—Receivers Loring and Morley, of the Union Street Railway Company, applied to Circuit Judge Snow for an order allowing them to issue tickets at the rate of six for 25 cents. The judge was of the opinion that this was not sufficient, and issued an order directing them to issue tickets giving seven rides for a quarter, with special tickets for school children and laborers, good for nine rides, for the same amount. It is said this order will be carried out at once.

Personal Notes.

MR. C. S. BRADLEY, the inventor, of this city, sails for Europe to-day, to be gone about two months on business.

MR. F. P. FISH, the well-known counsel of the American Bell Telephone Company and of the General Electric Company, is ill in New York with typhoid fever.

MR. GRANVILLE C. CUNNINGHAM has resigned the management of the Montreal Street Railway Company to take charge of the Birmingham (England) Tramway Company. He will be succeeded by W. F. Wanklyn, of Toronto.

Obituary Notes.

MR. ARTHUR DE LA MONTAGNIE LOZIER, assistant manager of the Bullock Electric Company, of this city, died from typhoid fever August 26th. Mr. Lozier was a graduate of Stevens Institute of Technology, and was well known among electrica and mechanical engineers. He was a brother of Mr. Robert T. Lozier, of the Bullock Electric Company, and his sudden and untimely death will be mourned by a large circle of acquaintances.

MR. EDWARD L. FRENCH, the general salesman of the American Electric Telephone Company, died at St. Vincent's Hospital, Toledo, Ohio, on August 21, from injuries received in an accident the week before at Put-in-Bay, Wis. Mr. French, who was but twenty-six years old, was cut off at the beginning of a life of brilliant promise. Possessing a large fund of good-nature, originality and wit, and much tenacity of purpose, he had endeared himself to a large circle of friends, who will sincerely mourn his untimely loss.

MR. GEORGE R. LEAN, superintendent of the Buckeye Electric Company, Cleveland, Ohio, died suddenly after a brief illness on July 9. He was widely known in electrical circles and had many warm friends among the fraternity. Mr. Lean had been in the service of the Buckeye Electric Company since 1893, and held the position of superintendent since 1895. In 1896 he was made electrician and superintendent of the Jandus Electric Company, dividing his time between these two important and responsible positions. He was an inventor of great merit, a fine mechanic and electrician, and held many important patents covering inventions used by the two companies with which he was associated. His untimely death at the age of 35 is deeply regretted by a host of friends.

Trade and Industrial Notes.

THE MAGNOLIA METAL COMPANY desires to announce that neither Messrs. H. G. Torrey, J. Gray Torrey nor Charles Taylor has any connection with its business.

MR. L. P. SMITH, of the importing firm of Smith & Patterson, sailed Thursday for Europe, to look after the importation of the Swedish telephone apparatus. Mr. Smith will return in about two months.

MACHADO & ROLLER, New York, sole agents for the sale of A. E. G. incandescent lamps, report large and increasing demands for this lamp, which, owing to its efficiency and longevity, has grown in popular favor among consumers.

THE MISSOURI TELEPHONE MANUFACTURING COMPANY of St. Louis, are having a hard time to keep even with their orders. The trade in their line is increasing daily, and their factory is crowded to its utmost capacity.

MR. WALTER C. McKINLOCK, Chicago, has been appointed by the American Electric Fuse Company its general Western selling agent for the Maxstadt combination double-pole porcelain fusible cut-out lightning arrester and other patent fuse and fusibe cut-outs.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., is general selling agent for the F. & L. push flush switch, which is one of the most compact switches on the market. The face plate is no larger than that of an ordinary one-light gas key, and the operation is on very much the same plan.

WAGNER SINGLE-PHASE MOTOR.—The single-phase motor made by the Wagner Electric Manufacturing Company, St. Louis, Mo., is meeting with a very friendly reception in the Western States. Messrs. W. D. Ball & Co., consulting engineers, of Chicago, who recently installed one of them for pumping water in a large flat building, speak very well of its operation.

UPTON "MIDGET" ENCLOSED ARC LAMPS.—The Standard Thermometer & Electric Company, Peabody, Mass., has issued a circular upon its Upton "Midget" enclosed arc lamps. These lamps, which burn 150 hours with one set of carbons, are only 22 inches in height over all. Their wide and extending use is a proof of the great satisfaction that they have given to those operating them.

A HANDSOME CATALOGUE.—The Detroit Lubricator Company, Detroit, Mich., has just issued a very neat catalogue, describing the different lubricating devices manufactured by the company for different kinds of engines. Besides showing a complete line of sight-feed lubricators, glass and brass oilers, globe valves, etc., it also contains some tables and data which are of general interest to all users of steam power.

A NEW I-T-E CIRCUIT BREAKER has been received by H. B. Kirkland, 120 Liberty Street, New York, agent of the Cutter Electrical & Manufacturing Company. The new instrument is arranged for overload and undervoltage, the two spools being made to act independently on the same trigger. It is fitted with the copper knives and carbon breaks of the other I-T-E instruments, and is made in various sizes, single and double pole.

POWER PUMPS.—The Goulds Manufacturing Company, Seneca Falls, N. Y., has just issued a very elaborate and handsome catalogue of its power-pump machinery, including a number of electric pumps and geared triplex pumps suitable for belting to motors. Among the more interesting types shown may be mentioned a direct-connected high-pressure triplex electric pump and heavy vertical triplex mine pumps direct-connected to induction motors.

"GIANT" P. & B. INSULATING PAPERS.—The Standard Paint Company, New York, is sending out samples of its "Giant" 1, 2 and 3-ply P. & B. papers, which are used for waterproofing and heat insulation and also for a certain class of electrical insulation. An interesting sample consists of a plate of tin punched with holes and covered with P. & B. compound, which completely fills the holes, showing its value for the mending of leaky roofs, vessels, etc.

THE H. W. JOHNS MANUFACTURING COMPANY, New York, has appointed Messrs. Bergtheil & Young, 12 Camomile Street, London, E. C., as their European representatives for the sale of their Moulded Mica trolley line, Vulcabeston and other insulating materials, and the "H. W. J." electric heaters for street cars and other purposes. The company anticipates an excellent export business during the coming year, based upon the reputation already acquired in foreign countries for quality of materials and prompt shipments.

IMPROVED HATCH ACCUMULATOR.—The Hatch Storage Battery Company, Boston, has just issued a neat little catalogue of its improved Hatch accumulator. These batteries are constructed in a peculiar and original way, the backing of the plates being a porous unglazed earthenware plate with receptacles for holding the active material. These are interleaved with lead plates and bound together to form the element. It is claimed that this battery is especially adapted for central-station work because of its enormously high rate of charge and discharge.

ELECTRIC RAILWAY SWITCHES.—The Central Electric Company, of Chicago, is issuing a very neat and comprehensive small catalogue of electric railway Quick-Break Snap fusible switches. These switches are made in various designs for controlling car-light circuits, also in combinations, so that one switch will control two head lights, as well as the car-light circuit. It is also sending out with these catalogues circulars of its changeable electric headlights. It has equipped a great many roads with these headlights, and in every instance satisfaction has been the result.

THE WALKER COMPANY, through its Western agents, has just sold two 200-hp Walker street-car motors of the open type, to go on the 6-foot Baldwin truck, for the Lake Street elevated railway. These motors will develop the maximum effective adhesion of each pair of 33-inch wheels equipped with motors under a 24-ton car, and are expected to make a speed of over 40 miles an hour, with a 100-ton train, and to accelerate to the maximum speed in 18 seconds. These motors are interesting, not only on account of being the largest ever built for street-car traction, but also because so much power has been condensed in so small a space as is contained in a 6-foot wheel base truck.

AN ISOLATED PLANT FOR A CHURCH and clergy house is being designed by Pattison Bros., 136 Liberty Street. The plant will be installed in the Episcopal buildings to be built on Eighty-eighth Street, New York City. Four 25-kw generators will be included, besides motors for ventilation, house pumps and organ pumps. The same firm is pretty busy making the plans for the large plant in the new Empire office building, where about 500 kilowatts of electric power must be provided for. They have also been retained by the architects of the new Turn Halle on Lexington Avenue and Eighty-fifth Street, and are just completing the rewiring of the Grand Central Palace for 150 enclosed arcs and 5000 incandescent lamps.

RAILWAY PANEL SWITCHBOARDS for generators and feeders now form part of the output of the works of the Wagner Electric Manufacturing Company, of St. Louis. Several styles have been adopted providing for one, two or four circuits, with single-throw main switches or double-throw for boosters. All panels are made of a uniform height of 90 inches, and are provided with all necessary angle irons, tie rods, turn buckles, floor brackets, etc. The switches are provided with the Wagner Company's carbon rod, which follows the switch knife in opening and takes the arc, thus preventing any burning of the contacts. The same company has also put on the market a direct-connected ventilating fan built in sizes from 24 inches to 72 inches diameter, and equipped with direct-current motors or their single-phase self-starting alternating-current motor.

THE JEFFREY MANUFACTURING COMPANY, of Columbus, Ohio, manufacturers of coal-mining machinery and other specialties, have just received a letter from Mr. S. W. Farnham, mechanical engineer of the Coal Companies of St. Louis, enclosing a report from Mr. James Cameron, superintendent of their No. 2 Western Coal & Mining Company's mine, located in Arkansas. In this report Mr. Cameron states that at their mine with a Jeffrey electric machine, equipped with self-propelling truck, they were able on the 13th of this month (August) to make ninety-five cuts in nine and one-half hours. This record was made by two of their men, all cuts being made with the same machine. This work was done in five rooms and two entries, and necessitated the changing of bits a number of times. It was necessary to load and unload the machine seven times.

A NEW BOOK OF WIRING TABLES has been issued by the John A. Roebling's Sons Company, Trenton, N. J. The information contained in it is unusually complete. Besides data customarily given this volume contains tables of the properties of bimetallic wire, specifications, effects of currents, properties of spans and information on rail bonds. An interesting statement accompanying the book reads as follows: When you walk from New York to Brooklyn you do so over the great New York and Brooklyn Suspension Bridge,

built by Roebling. When you talk from New York to Chicago by telephone you do so over No. 8 hard-drawn copper wire made by Roebling. When you telegraph from San Francisco to New York you do so over a continuous line of copper wire made by Roebling. When you cable across the Atlantic Ocean by the Commercial Cable you do so through copper wire made by Roebling.

LARGE ELECTRICAL EQUIPMENT ORDERS.—J. Holt Gates & Co., Western agents for the Walker Company, report the practical completion of that part of the suburban railway which is operated by electricity. These are part of the lines of the Chicago & Northern Pacific Railway Company. This plant, on account of the high speed of the service, promises to be the forerunner of the electrification of a number of steam roads in and about Chicago. They also report the sale of a number of large equipments to the Holland & Macatawa Railway Company; also the installation of a 50-kw direct-connected Walker dynamo for Rector's oyster house, Chicago; a 500-light machine for C. .T Roenitz Leather Company, Sheboygan, Wis.; a 150-light machine for J. L. Record, Peoria, Ill.; a 150-light and 180-light machine for H. S. Walker, Chicago; besides a number of motors and transformers. They also report the sale of a 3000-light alternator to the Maywood Electric Light Company, and of a Walker 800-kw generator to the Memphis Street Railway Company.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York City.

THE KLONDYKE GOLD FIELDS are now attracting the attention of the whole world, and the results of placer and quartz mining are fully equal to the finds of nuggets in the early California days, and extraordinary inducements are being offered to prospectors, practical miners and investors. By next spring the gold fever will have taken possession of thousands of people, and the Western roads will have all they can do to transport the fortune hunters. The Chicago, Milwaukee & St. Paul Railway and its connecting lines offer the best facilities for reaching the Alaska gold regions. For further information, address E. F. Richardson, Gen. Agt. Pass. Dept., 381 Broadway, New York.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUGUST 17, 1897.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

588,144. ELECTRIC TROLLEY DEVICE; S. Harris, Johnstown, Pa. App. filed Dec. 3, 1896. In an electric trolley device, in combination with a contact maker movable along a transverse shaft, which engages the conductor when the contact maker looses engagement therewith, insulating members between the said shaft and the electrical apparatus upon the car.

588,145. ELECTRIC TROLLEY DEVICE AND CONDUCTOR CONSTRUCTION THEREFOR; S. Harris, Johnstown, Pa. App. filed Jan. 20, 1897. In an electric trolley device, the combination of a base, arms thereon about transverse pivots, and a contact wheel carried by said arms and adapted to follow lateral variations of the conductor by its own movement about a horizontal axis.

588,170. METHOD OF AND APPARATUS FOR MULTIPLE RATE METERING FOR ELECTRIC CURRENTS; E. Oxley, Washington, D. C. App. filed June 19, 1897. In a system of electric current distribution, the method of separately metering the consumption of currents during different periods, which consists in connecting with each of a series of consumers' circuits a plurality or series of metering mechanisms, electrically controlled from a single point, the operative selection of one series, and simultaneously effecting from said point the connection of all the meters of that series and the disconnection of the other.

588,176. ELECTRICAL RAILWAY SYSTEM; W. B. Purvis, Philadelphia, Pa. App. filed June 29, 1896. A conduit having a series of openings in its top, flexible diaphragms covering said openings, an insulated conductor supported in said conduit, a contact point secured to and projecting from said conductor, a pin passing through said diaphragm and having its lower end adapted when depressed to contact with said point, and a movable flexible strip connected with an electric motor and adapted to depress said pin.

588,177. APPLICATION OF SOLAR HEAT TO THERMO BATTERIES; H. C. Reagan, Jr., Philadelphia, Pa. App. filed May 15, 1896. A plurality of standards suitably supported, a frame mounted thereon and having a mirror or mirrors secured thereto, in combination with thermo couples, suitably supported and having one set of junctions adapted to be heated by the focusing of the sun's rays from said mirrors and a cooling device at the other set of said junctions.

588,188. ELECTRIC CONTACT DEVICE; D. S. Shallenberger, Johnstown, Pa. App. filed Jan. 30, 1897. In an electric trolley, the combination of a contact-carrying arm longitudinally movable at its lower end in a fixed horizontal plane, with an upwardly spring-pressed arm pivotally secured to the contact-carrying arm, and adapted to transmit the upward pressure to the outer end thereof.

588,189. ACCUMULATOR BATTERY; J. V. & H. H. Sherrin, London, England. App. filed March 22, 1897. In a secondary battery element the combination of a conductor, a strip of spring, non-conducting material wound helically thereon, and interstitial active material, which is held in close contact with the conductor by the said strip during and after expansion and during and after contraction.

588,206. PROTECTIVE APPLIANCE FOR ELECTRICAL APPARATUS; A. S. Williams, Newton, Mass. App. filed May 7, 1897. A protective appliance adapted to be held in supports under spring pressure and normally forming an electric connection between the said supports but adapted to dissever the same, consisting of a metal thimble provided with a heating coil at one end, an insulated pin extending from the opposite end through the said coil, and a metal tube concentric with said pin and soldered to the bobbin of the coil.

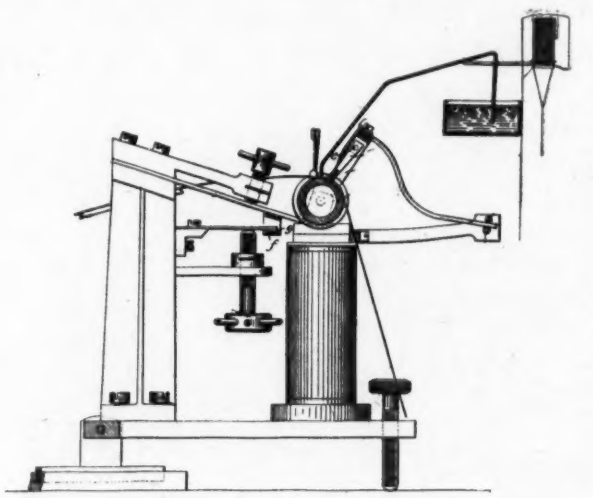
588,233. CARBON HOLDER FOR ELECTRIC LIGHTS; O. S. Moss, Syracuse, N. Y. App. filed Nov. 2, 1896. A carbon holder comprising a base having a concavity in its lower face, and provided with lateral ears, means of securing it to the lamp rod, side pieces having eyes in their upper ends, their faces adapted to grip the carbon, and means for holding them in engagement with the carbon.

588,246. COMBINATION VOLT GRADUATOR; W. J. Shields, New Wilmington, Pa. App. filed March 24, 1897. In an instrument for adapting the current from a commercial circuit to medical purposes, the combination of a conductor of high resistance placed across the terminals of a constant-potential supply circuit, a portion of which is connected at intervals to contact points, with, second, a lever arm pivoted so that it may make a sliding contact with said contact points, covering two or more points at a time; third, the remaining part of the conductor being so proportioned with reference to the resistance of the first part of the conductor, and the E. M. F. of the supply circuit as to secure safety to the patient and protect the instrument in case of a short circuit betweeen the electrode terminals while fourth, the resistance of the whole conductor is small, compared with the resistance of the human body.

588,251. RECORDING INSTRUMENT; W. Thomson, Largs, Scotland. App. filed Oct. 2, 1896. The combination of a marking point, paper and a platen having means in connection therewith for oscillating it to and from the marking point, and suitable means for feeding the paper forward as the platen is oscillated.

588,258. SWITCHBOARD APPARATUS; W. F. Banks, Milford, Conn. App. filed Oct. 1, 1896. In a telephone system, the combination of a plurality of contact strips, a plurality of contact springs connected thereto, a series of contact strips of greater length than the contact springs and insulated from each other and from the contact strips, a plug, contact plates mounted thereon, contact springs and contact pieces co-operating with the contact springs.

588,279. DIRECT-CURRENT GENERATOR; B. G. Lamme, Pittsburg, Pa. App. filed May 8, 1896. The combination with the field magnet of a direct-current electrical machine, of a commutator and a slotted armature core provided with a winding comprising a set of coils each of which embraces a space which is less than the distance between the centres of adjacent fieldmagnet pole pieces, and has its terminals connected to segments of the commutator cylinder, which are spanned by brushes of the same sign, whereby the desired counter E. M. F. in the short-circuited coils may be readily secured.



NO. 588,251.—RECORDING INSTRUMENTS.

588,300. AUTOMATIC RHEOSTAT CONTROLLER; R. Wilson, Louisville, Ky. App. filed May 29, 1897. In an automatic rheostat, the combination of an actuating lever, a cam moved thereby, a rheostat lever controlled by the cam, and means whereby the actuating lever is permitted to move a short distance independently of the cam.

588,320. LIGHTNING ARRESTER; C. C. Chesney, Pittsfield, Mass. App. filed May 14, 1897. In a lightning arrester, a series of concentric cylinders having flaring sides, said cylinders being spaced apart throughout their length, suitable insulated supporting means and circuit terminals, therefor.

588,396. ELECTRIC RAILWAY SYSTEM; J. Claret and O. Vuilleumier, Paris, France. App. filed August 4, 1896. A distributer for an electric rail-

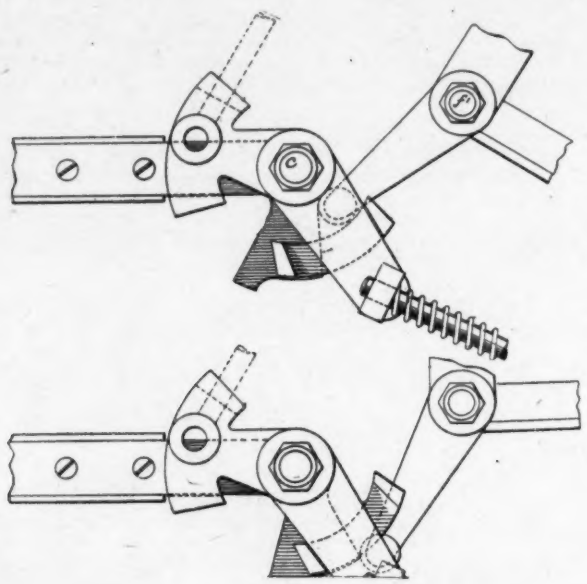
way, having a series of keys to be connected to the spaced contacts of the railway, contact arms to move over and touch said keys, an electric motor to move the said arms, a locking wheel moving with the motor, armature levers to lock the wheel, electromagnets to act on said armature levers, and an escapement actuated on by said armature levers to supply current to cause the motor to turn in one direction or the other, according to the direction in which the vehicle travels.

588,382. ELECTRICAL CONDUCTOR; J. D. Bishop, New York, N. Y. App. filed May 6, 1897. An electric conductor, composed of a plurality of wire ribbons wound side by side longitudinally of the conductor and having intervening air spaces.

588,428. FLUSH SWITCH; L. Heck, Newark, N. J. App. filed April 19, 1897. In an electric switch, the combination with stationary contacts and a movable contact lever, of a dog pivoted with the lever and provided with a fulcrum bar having stops at opposite ends, a spring hinged upon a stationary pin and having an eye fitted movably to the fulcrum bar, means, as the stud and shoulders, to move the contact lever with the dog, and a manual lever detachably connected with the dog to oscillate the same through a portion of its movement, the remainder of the movement being effected by the tension of the spring upon the fulcrum bar.

588,435. RAIL BOND FOR ELECTRIC RAILROADS; V. E. Hunter, Cleburne, Texas. App. filed June 24, 1897. A bond for railroad rails consisting of the combination with a railroad rail, of a split-headed axially and angularly bored coupling bolt, a connecting wire extending through the perforation and bent or coiled once around the bolt, and means for clamping or compressing the bend or coil of the wire firmly against the side of the rail.

588,448. TROLLEY; F. Krabal, Pittsburg, Pa. App. filed August 22, 1896. The combination with the trolley pole having the trolley wheel journaled therein, of standards or guides on said trolley pole, spring-operated levers on said trolley pole, and pivoted spring arms or guards on said levers within the standards or guides extending across the trolley wheel and movable laterally and toward each other.



No. 588,306.—Automatic Rheostat Controller.

588,465. TROLLEY BICYCLE; B. T. Oney, Charleston, W. Va. App. filed Sept. 10, 1895. A trolley-driven carriage arranged to run upon ordinary roads and having an electric motor geared to one of its wheels, in combination with a trolley pole connected to its main frame and carrying a double-wheeled trolley, two conductor wires arranged on opposite sides of the trolley and holding it between them, and branch wires leading from the two trolley wheels to the two poles of the motor.

588,479. ELECTRIC HERB PAD; A. Roedel, New York, N. Y. App. filed June 19, 1897. A medicinal pad comprising a bag or receptacle formed of fabric, a filling of medicinal herbs contained therein, and metal plates on the inner side of the pad adapted to set up an electric current by galvanic action when the pad is applied to the part to be treated.

588,483. APPARATUS FOR TREATMENT OF DISEASES; H. Sanche, Detroit, Mich. App. filed May 29, 1896. The combination with a shell containing a thermal pile or series of closely packed metallic rods, of a heating device, a conducting cable connected to the pile and a contact plate connected to the cable, and provided with means whereby it may be attached or applied to some part of the body.

588,488. TROLLEY; G. W. Sell, Jr., Johnstown, Pa. App. filed March 11, 1897. An improved wheel mounting consisting of a globular bearing, a wheel, and cups carried by the wheel and adapted to embrace the bearing.

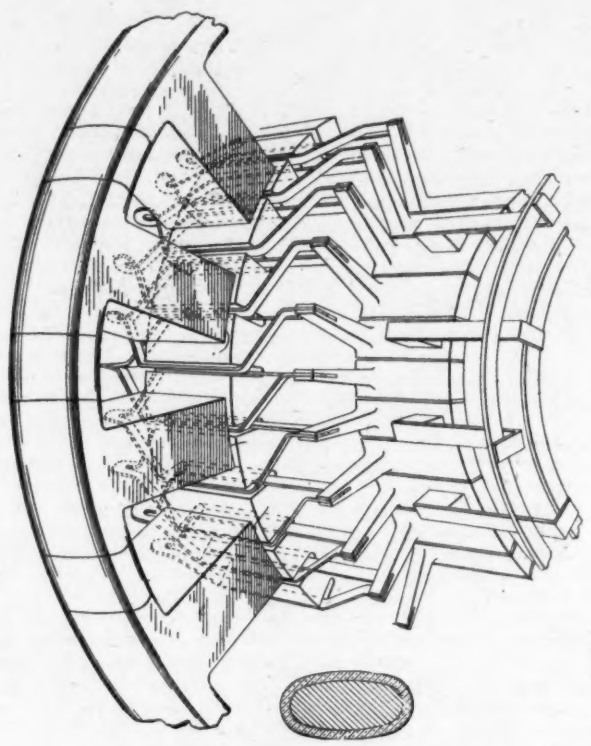
588,489. MAGNETIC SWITCH LOCK; S. H. Short, Cleveland, Ohio. App. filed Dec. 22, 1896. The combination of an electric switch for changing the path of the current, a mechanical latch therefor adapted to lock the switch in at least two positions, and an electromagnet connected in the main circuit and exerting its magnetic force to prevent the unlatching movement of said latch, and susceptible to the ordinary current flowing through the same.

588,490. BRUSH HOLDER SUPPORT FOR ELECTRIC GENERATORS OR MOTORS; S. H. Short, Cleveland, Ohio. App. filed Jan. 2, 1897. In an electric generator or motor, the combination of an adjustable rocker mounted concentrically with the commutator and a plurality of radially adjustable brush-holder hangers.

588,491. MULTIPOLAR DYNAMO, MOTOR, OR ROTARY TRANSFORMER; S. H. Short, Cleveland, Ohio. App. filed March 12, 1897. The combination with a multipolar dynamo, motor or rotary transformer having a plurality of magnets and a low reluctance magnetic circuit, of closed circuit metallic bands or conductors of low electric resistance inclosing the section of the magnetic circuit at some point in its length outside the armature.

588,511. TRANSMITTER; A. Van Wagenen, Sioux City, Ia., App. filed April 30, 1896. In a transmitter, the combination with a circuit making and breaking mechanism movable in a prescribed path, forward, and having no return or backward movement, and an indicator adapted to be set in one or more positions in the same or a corresponding path in advance of said circuit making and breaking mechanism, and to arrest the operation of said mechanism at a position corresponding to that occupied by said indicator, of power mechanism for operating said circuit making and breaking mechanism adapted to cause said mechanism to travel over its entire path at each actuation thereof.

588,528. ELECTRIC RAILWAY; R. M. Hunter, Philadelphia, Pa. App. filed July 19, 1886. Divided and re-filed July 20, 1895. The combination of a car having a body supported on the axles by springs, field magnets having connected therewith journals sleeved upon the axle and supported independently of the car body, an armature and shaft mechanically connected with the axle so as to rotate with a speed commensurate with that of the axle, a secondary battery carried upon the car body, electric circuits connecting the field magnets and armatures with the batteries, a lighting circuit on the car body, switches for connecting the lighting circuit with the electric circuits leading to the armature and field magnets or with the secondary battery, and means for varying the E. M. F. of the battery.



No. 588,491.—Multipolar Dynamo, Motor, or Rotary Transformer.

588,536. FUSE BLOCK; H. A. Sinclair, Brooklyn, N. Y. App. filed March 9, 1897. A fuse block consisting of a body part of insulating material provided with lateral extensions having vertically arranged grooves in their opposite faces, and angular contact pieces provided with means for securing them in said grooves, in combination with fuses joining said contact pieces together in pairs.

588,541. CURRENT-CONDUCTING RAIL FOR ELECTRIC RAILWAYS; L. E. Walkins, Springfield, Mass. App. filed May 21, 1897. A current-conducting rail for electric-railway systems, having a body of iron or steel, and having its treat side covered with a layer of copper, welded thereto.

RE-ISSUE.

11,626. ELECTRIC BURGLAR ALARM; C. Coleman, Chicago, Ill. App. filed (for re-issue) Jan. 18, 1897. In a burglar alarm, the combination of a local alarm circuit, a main circuit extending from the alarm station to the guarded structure, a meter electrically connected with the main circuit and adapted to complete the alarm circuit upon a variation in the condition of the main circuit, and a switch for electrically throwing in first the main circuit and then the alarm circuit, and electrically throwing out first the alarm circuit and then the main circuit.